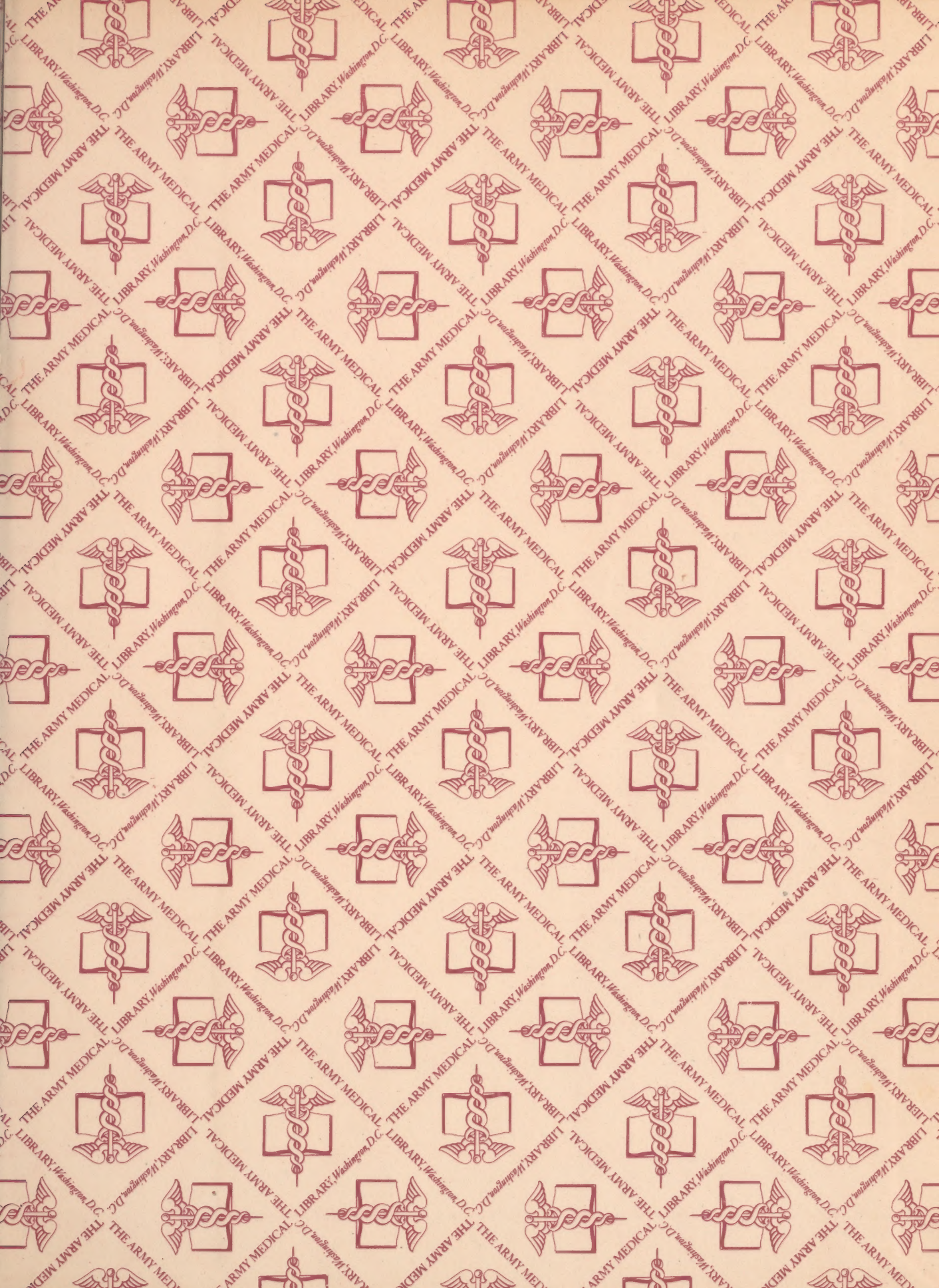
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OPERATING ROOM TECHNIQUE

FOR

SURGICAL TECHNICIANS

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Chapter I

DRESSING OF THE WOUND

To "dress" a wound is to treat it in one or more of numerous possible ways for the promotion of its proper healing. A clean and uninfected wound which heals naturally will thus require nothing more than the removal of the superficial or nonabsorbable sutures as soon as they have served their purpose (in from 5 to 10 days or longer sometimes), such sutures otherwise eventually acting as irritating foreign bodies. But a seriously infected wound will require frequent and thoroughgoing attention from the beginning in the way of irrigation with some non-irritating antiseptic solution to remove from it pus, dead tissue, secretions, bacteria themselves, etc.; of keeping it draining freely by opening pus "pockets" sometimes, and by inserting suitable drains; of washing the surrounding skin to cleanse it of the wound drainage and of treating it with ointments, etc., to keep it from getting sore; of replacing soiled and uncomfortable dressings with clean and comfortable ones.

Before any of these things can be done, however, there are a great many important nursing duties to be carried out in the way of assembling and preparing supplies and organizing technic for their use.

SUPPLIES

The following supplies, presented alphabetically for the sake of order, will probably answer for all but very exceptional dressing:

Adhesive Plaster. Rolls of all widths or a wide roll from which any size of strip may be torn for binding on the dressing or a splint must always be on hand. Some wounds, moreover, will be strapped by applying the plaster directly to them (without intervening dressing) in which case the plaster must be sterile. It can be purchased sterile but is very easily sterilized by passing it (only the adhesive side) quickly two or three times through the flame of an alcohol lamp or a gas burner.

Applicators. See under "Cotton" below.

Bandages and Binders. Gauze bandages of all sizes are kept on hand always, and other bandages and special binders must be in reserve for the occasional case - muslin bandages especially for some of the splints which must be removed and reapplied for a dressing.

Basins. The small kidney-shaped basin which is so universally useful in nursing is a standard piece of equipment for a dressing. In addition there must be a large basin (or a pail or heavy paper bag) for reception of the soiled wound dressings and another one, or better a pail, for disposal of solutions when wounds are irrigated, a small one (1 pint) for the solution used for syringing, and a large hand basin (1 gallon) for a 1-1000 solution of bichloride of mercury for rinsing hands between cases.

Carrel-Dakin Equipment. Show the kinds of syringe and tubes suitable for treatment of wounds with the Dakin solution.

Cotton. A plentiful supply of absorbent cotton sponges will be in demand for almost any dressing. These are made by tearing (not cutting) the cotton into small circular pieces and then gathering together the edges (so as to make a ball an inch or more in diameter) and twisting them tightly, using a little water on the fingers.

For sponging of small wounds and sinuses and for the application of drugs (iodine, etc.) small applicators or swabs made by twisting a small piece of cotton onto the end of a toothpick or a longer piece of polished wood will be all but necessary in the dressing equipment.

Culture Tubes. Because it will sometimes be desirable to take specimens of the drainage from a wound at the time of the dressing for examination and diagnosis the two types of culture tubes should be in reserve, the one containing the culture medium being stored in the refrigerator till needed.

Drains. Rubber tubing of assorted sizes, rubber dam in squares of 4 or 5 inches, gutta-percha tissue in squares of 3 or 4 inches and an assortment of rubber bands will probably fill all needs for drains required at dressings.

Dressings. See under "Gauze" below.

Drugs. The solutions, ointments, etc., which will be called for at dressings will vary from time to time, as favorites come and go, and each surgeon will have his own preferences for most purposes but a representative list would be something like the following:

Acrifflavine
Alcohol
Balsam of Peru
Benzine--for removal of adhesive plaster as well as for washing of the skin sometimes
Bichloride of mercury, 1-1000 solution
Boric acid, 4% solution
Burrow's solution (aluminum acetate)
Dakin's solution
Ether
Iodine (tincture)
Mercurochrome
Ointments--boric acid, zinc oxide, ammoniated mercurial, Lassar's paste, scarlet red, etc.
Peroxide of hydrogen
Powder--boric acid, zinc oxide, aristol, talcum, etc.
Salt solution (normal)
Silver nitrate--10% solution and "stick"
Soap (green) solution
Vaseline

Gauze. For the wound dressings the "folded dressings," "wipes," "fluffs," and "rolled compresses" described for operating room use will be applicable also as ward dressings, and for sponging of the wound the "cherry" described in that same section will be useful.

Also, there should be on hand for dressings the same assortment of gauze packing as that described for the operating room, including the iodoform variety.

Another form of gauze dressing considerably used is the vaseline gauze which means simply strips of bandage gauze impregnated with vaseline which will be spread upon the skin around a wound to prevent its becoming sore in cases of irritating wound drainage. To make this dressing cut a 2-inch bandage into strips about 6 inches in length, lay these perfectly smoothly and one at a time in an oblong enameled basin or pyrex dish which has a well-fitting cover, folding up an end of each strip for about half an inch so that it can be more easily picked up for use. Then melt and pour over this gauze just enough vaseline to cover it and sterilize in the autoclave.

Gloves. Rubber gloves will be desirable as a rule for the person who does the dressing.

Gowns. It will be best technic for the person who does a dressing to wear a sterilized gown.

Instruments. An elementary set of dressing instruments consists of one pair of scissors (one blade sharp-pointed for removal of sutures,) one pair of plain anatomical forceps, one pair of dressing forceps, and either a probe or a grooved director. If the metal clips have been used for closure of the skin special forceps will be necessary for their removal. In reserve there should always be several hemostats, a scalpel, an assortment of suture needles, needle holder, and a little catgut and silk thread.

Irrigator. For those wounds which are irrigated some such irrigator and elevating stand will be necessary. And as the "tip" for insertion in the wound in this treatment a rubber catheter will be usual.

Packing. See under "Gauze" above.

Rubber Sheet. An ordinary double-coated rubber sheet about one yard square will be necessary for protection of the bed in all dressing cases where there is drainage from the wound or where the wound is to be irrigated or syringed.

Safety Pins. A few large and medium-sized safety pins must be sterilized and ready principally for passing through drains at the surface of the wound to keep them from entering farther than is desired.

Spatulas. Some such instrument will be needed for handling of ointments. There are many kinds available but the most convenient article for the purpose is the ordinary hard-wood tongue depressor which can be sterilized in the autoclave.

Syringes. For small wounds a syringe will be used instead of the elevated reservoir for irrigation.

Towels. For every dressing at least one towel and oftener two or more will be needed for sterile draping about the wound. Any kind of towel will do but unbleached muslin, about 22 x 36 inches in size, is perhaps the most desirable material.

STERILIZATION AND STORAGE OF SUPPLIES

How one prepares and arranges these supplies for use will depend largely upon circumstances and other general equipment. If it is a case of a single dressing, as in the home, wound dressings, sponges, draping towels, and any of the other smaller articles which can be sterilized in the autoclave may be combined in one muslin-covered parcel, and the other articles may be boiled as needed. In hospitals, however, where numerous dressings must be done in immediate succession there must be a common source of supply. This can be managed by sterilizing the supplies in muslin-covered parcels and then transferring them to glass or enameled metal jars which have been sterilized separately and which have dust-tight covers. The best technic, however, is to use the supplies directly from the container in which they were sterilized provided it can be safely opened and closed repeatedly. This will save much time and work and it eliminates the exposure incident to transferal from one container to the other. There are metal dressing boxes for this purpose and wherever possible they should be used, a sufficiently large one being chosen so that all supplies (dressings, sponges, applicators, draping towels, etc.) for at least an average "card" of dressings may be combined in this single parcel.

The dressing instruments will be boiled freshly at the time of the dressing and if possible they should be carried to the bedside in the boiler and dispensed directly from it only as needed. Thus for a long series of dressings, the needs for which can usually be fairly accurately judged in advance, a full set of instruments need not be provided and unsterilized for each patient for in many cases only a pair of forceps or forceps and scissors will be needed.

The gloves may be prepared either dry or wet, the same as in the operating room.

The rubber and gutta-percha drainage materials are best kept in solutions in glass jars.

Such things as the irrigator, wound syringe, etc., may either be kept wrapped sterilely or they may be boiled as needed. Other miscellaneous supplies which are used only occasionally may be kept sterilized in individual parcels or in dust-tight jars.

To have all these necessities conveniently at hand, especially when more than one dressing is to be done at a time, will call for some means of compact and easy portability. There is always the tray, of course, but when a variety of dressings are to be done the items it must accommodate will be so numerous and so heavy that it will be cumbersome and not very satisfactory generally. When there is room for it the most convenient and technically the best means of storing supplies and transporting them from one patient to another is one of the dressing carriages which are made in

different sizes and designs. If one has an electric instrument sterilizer and accessible wall outlets about the ward for its attachment it too may be kept on this carriage and used to resterilize instruments as used, thus economizing in instrument supply as well as in time and labor.

TECHNIC FOR THE DRESSING

First of all, it must be remembered, of course, that until the skin has firmly healed a wound can be infected at its dressing, so some system of aseptic technic must be organized and carried out for all wound dressings. This means that while nurses will not regularly do the actual dressing the results of it, nevertheless, and so the progress of the wound toward recovery are very considerably at their mercy as they prepare and dispense all articles used for the treatment. A nurse who has had her operating room course will understand this and it is probably not going too far to say that the operating room course should be a prerequisite for appointment to important nursing responsibility for wound dressings.

When a number of dressings are to be in immediate succession by the same persons and from the same source of sterile supplies they should be done in the order of their state as to infection - clean ones, and then the least virulently infected ones preceding the others.

Then, the first step in any dressing is to make the patient as comfortable as possible before beginning it. The bedding is turned back neatly and out of the way on all sides of the wound with no more exposure for the patient than is necessary, extra blankets being used in cold weather to take the place of the regular covers on such parts as the chest and feet when possible. If you make your patient feel comfortable before you begin his dressing you have thus already made considerable headway with it for both him and yourself.

The exposure of the wound will usually involve the removal of adhesive plaster. Patients in good condition, and especially those in good spirits, will not mind the direct method of pulling off adhesive plaster but nervous and sensitive patients, very ill ones, and especially children, will often be much disturbed unless some gentler method is used. Any oil--albolene or olive oil--will soften the plaster in a few minutes and benzine will dissolve it in a few seconds. However, if iodine has been used as the skin sterilizer in the operating room the skin may be tender and even broken under the adhesive and benzine will be painful in such cases so an oil must be used instead.

In cases where the skin shows a tendency to become sore, or where it is already so; where a patient is particularly disturbed by the removal of the plaster; or where the dressings need to be changed frequently, some device may be used for keeping the dressing in place. This consists merely of pairs of adhesive straps connected by tapes which are tied across the dressing. These straps will remain in place for a long time and will answer all purposes of a continuous strap except that of great tension.

After the dressing has been removed the sterile draping is done, a sterile dressing towel being placed immediately above and another below the wound, great care being used to handle these towels by only one edge or two corners so that instruments, dressings, etc., may be safely placed upon them if that is found convenient. And if the wound is to be irrigated a rubber sheet covered with a dressing towel should be placed under the patient directly under the wound to protect the bed, for though the little curved basin can nearly always be fitted in so as to catch the drainage there will be times when this extra rubber sheet will save remaking of the bed after the dressing.

The surgeon (it may sometimes be a nurse), wearing sterile gloves and possibly a sterile gown, then proceeds to do the dressing and the assistant nurse to dispense whatever may be needed of the supplies.

With care and experience all sponging of the wound and handling of dressings can be done with forceps using one in each hand. In this way gloves may be kept clean throughout any number of dressings and so need not be changed between them, though as a safeguard against unconscious error of technic they should be well rinsed after each case in, say, a 1-1000 solution of bichloride of mercury.

The general principles of handling sterile supplies for dressings are the same as those for the operating room, namely, to have everything so arranged as to require the least possible amount of handling. This point cannot be urged too often, not only in the interest of asepsis but also because it saves time, labor and confusion. A good and standard practice is to keep a pair of long sterile forceps and a pair of scissors for the purpose in a tall jar containing a solution of 1-40 or 1-60 carbolic acid to which a few grains of borax have been added for the purpose of preventing rust. These can be kept on the dressing tray or carriage at all times and as long as they are used for nothing but the perfectly sterile dressings they need not be reboiled oftener than once a day. The point that these scissors and forceps should be long ones is emphasized because their length will enable the nurse to keep her unsterile hands well out of the region of the opening of the sterile container and thus to avoid the possibility of unsterile dust dropping from them onto the supplies.

In this connection it should be urged upon the person who dispenses the sterile supplies to keep her hands as well washed as possible. It will not be necessary for her to sterilize them but she should avoid, as far as she can, the removal of dressings and the application of adhesive plaster, bandages, etc., after the dressing is done especially in infected cases, if she is to go to another wound immediately. If an assistant is available this part of the dressing should be left entirely to her, and otherwise one's hands must at least be well washed between contacts with the wounds of any two patients.

In any event, however, soiled dressings should always be handled with forceps. These need not be sterile but it will be just as well to keep them in a jar of the weak carbolic solution on the dressing tray or carriage, though the precaution should be taken to use for this purpose a different design of forceps and jar from those provided for the sterile work, and they should be kept as far away as possible from the sterile ones so as to check the user from the wrong one in a moment of lapse of attention.

Another item of technic in connection with wound dressings which must be watched closely, but which seems to be overlooked often, is that of the care of one's bandage scissors when they must be used to cut away an infected dressing. They can be very dangerous carriers of infection from one patient to another as well as to one's self and should be sterilized after such cases before being used again just as anything else is as a matter of course.

Still another reminder to the nurse dispensing the dressing supplies is that the mouth of a solution bottle should be cleansed before the solution is poured over it if it has no protecting cap--at least wipe away the dust with perhaps an alcohol sponge.

AFTER THE DRESSING

As soon as possible after the dressing the patient and his bed must be restored to their usual state. A little discomfort saved here, and a little there, hastens the recovery of health and happiness more than strong and well people realize sometimes.

The dressings done, all exposed supplies will be resterilized. However safe one's containers may be, and however good one's technic, it must be remembered that no container which is opened and closed frequently can be considered sterile indefinitely. The plan advised for the operating room dressing supplies will apply here also, especially when inexperienced students are concerned. That is, do not hold over from one day to another a used dressing box even though you may feel convinced that it has not been unsterilized.

The Carrel-Dakin Treatment. An infected wound will sometimes be so dressed that the Dakin solution may be constantly kept in contact with its interior afterward for the effect this solution has of dissolving products of infection and of killing germs to some degree, and for the irrigation thus effected.

Under this system some one or more (often many) rubber tubes designed will be inserted in the wound and kept projecting through the dressing so that the solution may be injected into them without disturbing the dressing. In some cases a syringe will be used for the instillation and in others an elevated reservoir will be connected to the tubes.

Enough solution to fill the wound (without overflow) will be injected every two hours, or sometimes it will be given continuously by using a dropper tube in the delivery tube of the reservoir as for the continuous method of saline infusion.

All of these wounds must be completely surrounded by the vaseline gauze because the Dakin solution is irritating to the skin.

When these tubes are removed from the wound they should be put into a germicidal solution at once (not allowed to become dry) and left to soak for several hours before handling for washing. Dakin's solution is the best one for the purpose but cresol and carbolic acid are also suitable.

For washing the tubes rubber gloves should be worn and a forceful syringe used for thoroughly flushing the interior, first with plain water and then with soap and water, with final rinsing, much patience being necessary sometimes to make sure that none of the perforations remain clogged. Stretching the tube lengthwise so as to enlarge the perforations while syringing it will usually help. Very thorough boiling will be necessary for such tubes as these before they are used again.

TOP OF DRESSING CART

A. Small basin containing alcohol sponges.

B. Small basin containing dry sponges.

C. Safety pins.

D. Cotton applicators.

E. Tongue blades.

F. Abdominal pads.

G. 2 x 2 dressings.

H. 4 x 4 dressings.

I. 4 x 8 dressings.

J. Hypodermic needles set in gauze.

K. Hypodermic syringes, 2 c.c., 10 c.c. and 30 c.c.

L. Fluffs.

M. Towels.

N. Instruments, to be arranged as follows, from left to right: 12 curved Kelly hemostats, 6 straight hemostats, 6 mosquito forceps, 3 smooth thumb forceps, 3 rat-toothed thumb forceps, 2 Bard-Parker knife handles with blades;, in back of these instruments are placed 2 probes, 2 grooved directors, and drainage tubes.

O. Medicine glasses.

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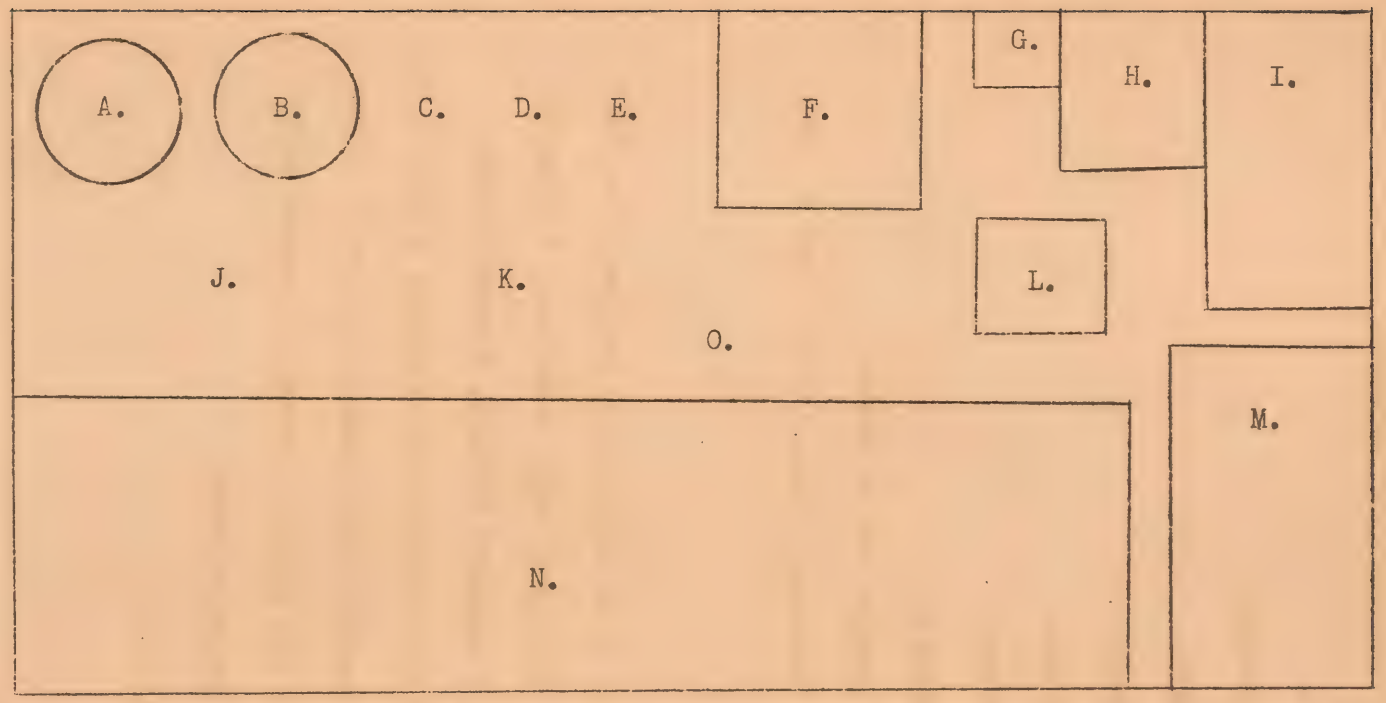

ARRANGEMENT FOR THE TOP OF THE DRESSING CART

BOTTOM OF DRESSING CART

A. Either box or can containing assorted gauze bandages.

B. Cans with covers containing extra sterile pads, and dressings.

C. Large basin for dirty and used instruments.

D. Space for adhesive tape and bandage scissors.

E. Glass graduate containing two Hysterectomy forceps in antiseptic solution.

F. Space for medicine.

Also, attached to the back of the cart is a small sheet containing pockets, in which are placed extra supplies, and rubber gloves wrapped, and attached to the bottom of the cart, a bucket for dirty dressings.

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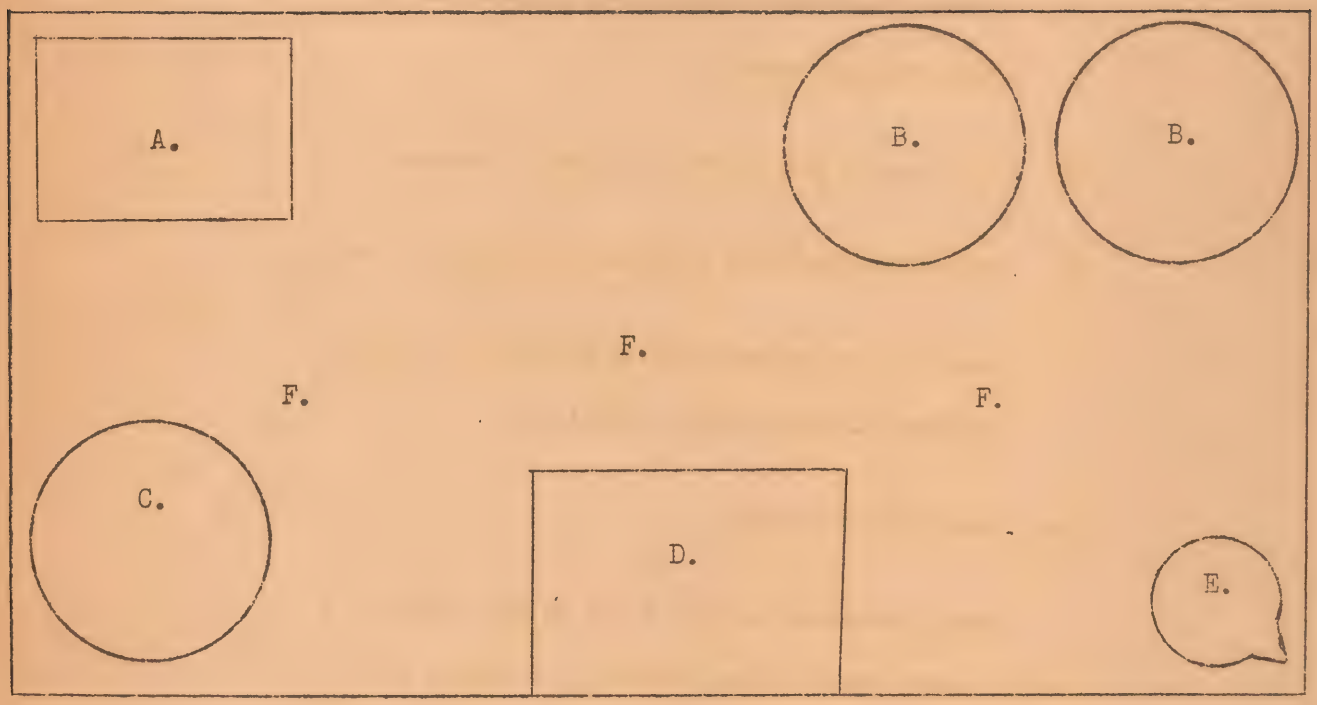


ARRANGEMENT OF THE BOTTOM OF THE DRESSING CART

Chapter II

GAUZE SUPPLIES

Gauze is a thin loose meshed weave of cotton. Its type varies according to the size, quality and number of threads each way per square inch of the weave. There are seven standard weave constructions:

20 x 12)
20 x 16) These four constructions are commonly used for dressings. The coarsest being the most universally accepted (20 x 12).
20 x 18)
24 x 20)

28 x 24)
32 x 28) These three constructions are commonly used for bandages, abdominal pads, masks, vaseline gauze, etc.
44 x 40)

Gauze can be purchased in any one of several forms:

(1) "Flatfold", Bolts, e.g., 100 yard pieces, folded a yard square with a selvage at either end.

(2) "Doublefold" Bolts, e.g., 100 yard pieces, 2 yards wide with a selvage at either end doubled to make 1 yard width and rolled on a cardboard.

(3) "Ready-cut-Gauze", e.g., 100 yard packages of gauze cut into convenient sizes, ready to fold.

(4) Dressing Rolls, e.g., 100 yard length of gauze, 4½" wide, eight ply. 4½" and 9" wide, folded four ply.

The American College of Surgeons in conjunction with the Committee on Simplification of the American Hospital Associations and the United States Department of Commerce have attempted to standardize the sponges, dressings, etc.

The reasons for establishing these standards are:

(1) To provide surgeons and hospitals with adequate dressings.

(2) To eliminate minor differences in technic in the various hospitals.

(3) To eliminate waste in using dressings, sponges, etc., which are too large for the purpose.

(4) To aid in the economy program of the hospital by the elimination of waste of materials as most standard dressings can be cut without waste from the commercial forms of gauze.

(5) To make it possible for manufacturers to produce standard dressings ready for sterilization which by the elimination of operating room help should in the long run be a further saving to the hospital.

STANDARD NOMENCLATURE:

(1) Sponges: Dressings for sponging or wiping to absorb pus or blood during an operation.

(2) Abdominal Packs: Dressings for walling off of abdominal cavity.

(3) Sterile Gauze Dressings: Sterile gauze dressings to cover wounds.

(4) Pads: Dressings to absorb drainage after operations.

(5) Gauze Drains:

(6) Dressings: For special purposes.

In preparing gauze for sponges, dressings, etc., the entire piece of "Flatfold" bolts - 100 yards pieces folded one yard square with a selvage at either side is used as a basis. This may be cut in three different ways according to the size, sponge or dressings, etc., one desires to make.

To make Type I, the entire bolt of "Flatfold" gauze is laid on a table and the two folded edges are removed with an electric cutter. This gives 100 pieces of gauze one inch short of being one yard square, having two selvages and two raw edges. This is cut from cut edge to cut edge 24" from the selvage thus making two pieces approximately 24" x 36" and 12" x 36". The 24" x 36" piece is cut in half from selvage to cut edge and the 12" x 36" piece is cut into three parts roughly twelve inches apart. This gives five pieces of gauze, two 24" x 18" and three 12" x 12".

To make Type II, the entire bolt of "Flatfold" gauze is laid on a table and the two folded edges are removed with an electric cutter. This gives 100 pieces of gauze one inch short of being one yard square having two selvages and two raw edges. The gauze is then cut from raw edge to raw edge twelve inches from the selvage. This gives three pieces of gauze approximately 36" x 12".

To make Type III, the entire bolt of "Flatfold" gauze is laid on the table and the two folded edges are removed with an electric cutter. This gives us 100 pieces of gauze one inch short of being one yard square having two selvages and two raw edges. The gauze is then cut from raw edge to raw edge eighteen inches from the selvage; this gives two pieces approximately 18" x 36".

Sponges:

Sponges vary in size and are known by their approximate final measurements when folded as:

8 x 4
4 x 4
3 x 3
2 x 2

Large Sponges ($8\frac{1}{2}$" x 4") (Standard) Operating Room Dressing. - For these sponges use the 24" x 18" pieces of gauze from Type I.

(1) Place gauze on a flat surface with 24" side towards you.

(2) Fold over both 18" edges about 3/4 of an inch.

(3) Fold upper edge of gauze 24" side down to center of gauze.

(4) Fold lower edge of 24" side of gauze up to the center.

(5) Fold gauze at center making it four ply and approximately $4\frac{1}{2}$" x $22\frac{1}{2}$".

(6) Fold each end in so that the length is divided into three equal parts approximately 8" x $4\frac{1}{2}$".

These may also be bought as "Ready-cut-gauze" or folded and ready for sterilization.

Sponges (4 x 4) (Not Standard) Ward Dressings. - For these sponges use the 12" x 12" pieces of gauze from Type I.

(1) Place the square piece of gauze on a flat surface.

(2) Fold the upper edge down three inches, making the piece of gauze 12" x 9".

(3) Fold the gauze into three parts from side to side, making the upper layer a little short of the edge, so that no raw edge projects.

(4) Take the gauze 9" x 4" and fold the lower raw edge up one inch and the upper edge down four inches. Tuck the lower edge into the pocket. This gives you a sponge about 4" x 4".

Sponges (3 x 3) (Standard). - For these sponges use the 12" x 12" pieces of gauze, Type I, folded the same as the 4" x $8\frac{1}{2}$" large sponges.

(1) Place gauze on a flat surface.

(2) Fold over two opposite edges about 1/2 inch.

(3) Fold other two edges to center line of gauze.

(4) Fold again at center line making gauze four ply and approximately 3" x 10 1/2".

(5) Fold each end in so that the length is divided into three equal parts, making a finished product about 3" x $3\frac{1}{2}$".

These may also be bought as "Ready-cut-gauze" or folded and ready for sterilization.

Sponges (2 x 2) (Standard). - For these sponges the 12" x 12" pieces of gauze are used. These are placed on a flat surface and cut down the middle in each direction so as to make flat pieces of gauze 6" x 6". These

pieces are folded in the same manner as the standard 3" x 3" sponges. These may also be bought as "Ready-cut gauze" or folded and ready for sterilization.

Sponges(2 x 2) "Not Standard). - In making these sponges the procedure is similar to that used for the 4" x 4" sponges. Take the gauze cut 12" x 12" and cut it in half, making the pieces 12" x 6".

(1) Lay the gauze on a flat surface with the 6 inch side toward you.

(2) Fold the gauze back 5 inches towards you, making the piece about 7" x 6".

(3) Fold the 6 inch width into three not quite equal parts, bringing the uppermost layer not quite to the edge so that the raw edge does not project. The only raw edge is the one towards you.

(4) Fold the length (7") of the gauze into three equal parts. Bring the upper third down and the lower third up.

(5) Tuck the raw edge of the lower third into the folded upper third; this gives you a square about 2" x 2" with no raw edges showing.

Small Fluff (Standard) "Tonsil Sponges." - For these sponges the 12" x 12" pieces of gauze from Type I are used. These are placed on a flat surface and cut down the middle in each direction so as to make flat pieces of gauze 6" x 6".

These pieces of gauze are folded, not creased, in the following manner:

(1) Each corner of the 6" x 6" gauze is folded towards the center.

(2) This makes a new square. Each of the corners of this square are folded toward the center. This gives us a fluff sponge which is not creased and is approximately 2" x 2" square.

Ward Dressings.--For this purpose use the 4" x 4" flat sponges described on page 43.

Finger Rolls (Not Standard). - These are made by taking the whole pieces of "Flatfold" gauze with the folded edges removed and cutting it into three parts (Type II) each 36" x 12".

(1) Place the gauze with the 36" selvage side towards you.

(2) Fold each of the ends of the gauze in about 2 inches so that there are no raw edges at either end. The piece of gauze is now about 32" x 12".

(3) Fold the 32" raw edge down about three inches, leaving a piece of gauze 32" x 9".

(4) Fold in half, bringing the upper folded edge down to the selvage, making piece 32" x 4 1/2" and of three thicknesses.

(5) Roll this loosely, making a small gauze roll $4\frac{1}{2}$" wide, three ply.

Small Flat Gauze Dressings (12" x 4½") (Standard) (Operating Room Dressings). - For these dressings use 36" x 12" stock gauze cut from "Flatfold" bolt according to Type II.

(1) Place 36" x 12" stock gauze with selvage towards you.

(2) Fold top 36" edge down about one inch. If there is no selvage fold bottom edge upward for about one inch.

(3) Fold each 12" edge toward the center line so as to meet and make a piece of gauze approximately 18" x 12".

(4) Repeat fold of 12" edge in the same manner folding it at the center so as to make the piece approximately 9" x 12" and four ply.

(5) Fold in center bringing both 12" edges together, making gauze dressing approximately 4½" x 12" and eight ply with no raw edges.

OR

One may use the 4½" eight ply dressing roll, cutting off a piece about 13" long and folding in each end about 1/2". This gives us the Standard Small Flat Gauze Dressing 12" x 4½".

Large Flat Gauze Dressings (4½" x 18") (Standard). - These are made by taking the pieces of "Flatfold" gauze cut 36" x 18". Type III.

(1) Place piece of gauze with 36" side toward you and fold raw edge of 36" side about 1/2".

(2) Fold both 18" sides in so as to meet at the middle, making a piece 18" x 18" and two ply.

(3) Fold both these sides again so as to meet at the center, making a piece 18" x 9", four ply.

(4) Fold again at the center, this gives a piece of gauze approximately 18" x 4½" and eight ply.

OR

One may use the 4½" eight ply dressing roll, cutting off a piece about 19" long and folding in each end about 1/2"; this gives us the Standard Large Flat Gauze Dressing 4½" x 18".

Medium Sponges (4" x 4") (Standard). - To make these sponges it is necessary to cut the 36" x 18" Type III pieces of gauze, in half, making two pieces 18" x 18".

(1) Fold in two opposite edges 3/4".

(2) Fold opposite sides down and up so as to meet at the middle.

(3) Fold at middle; this gives a piece of gauze 18" x 4" approximately.

(4) Both ends are folded in at A and B so as to meet at the center.

(5) It is then folded at the center C, making a square approximately 4" x 4".

Dakin's Pads (Not Standard). - In using the Carrel-Dakin treatment a large absorbent pad is required. The basis of this pad is a piece of absorbent cotton 12" x 12", which is covered with gauze.

(1) Take piece of gauze 26" x 18" (Type III). Place it on a flat surface with the short side towards you.

(2) Place 12" x 12" piece of absorbent cotton three inches from the end and three inches from either side.

(3) Fold three inches of end closest to you over cotton.

(4) Fold both sides over cotton for a distance of three inches.

(5) Bring down the long piece of gauze with both sides folded and cover all the cotton. This leaves you a piece of gauze 8" x 12" projecting over the end.

(6) Tuck this piece between the two pieces of gauze that were first folded in.

Large Dressing Pads (12" x 16") (Standard). -

(1) Take "Flatfold" cut gauze cut 26" x 16" with 26" side towards you. (This may also be bought as "Ready cut gauze".)

(2) Cut a piece of absorbent cotton 16" x 12" from the roll.

(3) Place 16" x 12" piece of absorbent cotton on gauze so that it is centered and parallel to each 16" side.

(4) Fold gauze over cotton so that it overlaps and leaves both 12" sides uncovered.

This pad may be made so as to have the center portion thicker than the sides and the entire surface covered with nonabsorbent cotton - in which case the following steps may be inserted.

(2A) Cut a piece of absorbent cotton 8" x 12" from the roll.

(2B) Cut a piece of nonabsorbent cotton 16" x 12".

(3A) Place the 8" x 12" piece of absorbent cotton in the middle of the 16" x 12" piece with the 12" sides parallel to the other 12" sides.

(3B) Place the 16" x 12" nonabsorbent cotton over the absorbent cotton, so that all edges coincide.

Amputation Pads (Not Standard). - These are made exactly like Dakin's Pads; the cotton, however, is cut 12" x 22" in size and a piece of gauze 36" x 36" is used to cover it. They are folded exactly the same as Dakin's Pads.

Extra Large Dressing Pads (24" x 10"). - Although these are not standard most manufacturers of gauze dressings carry this size.

These are constructed exactly the same as the large dressing pads (Standard), except that the filler must be 24" x 10" and the gauze cut 24" x 24".

Maternity Pads (Standard). - These may be purchased "Ready made" for sterilization.

(1) Cut the "Flatfold" gauze into pieces 22" x 10". Place the 22" side towards you.

(2) Cut from a roll of cotton or cellucotton absorbent wadding, a piece 9 3/4" x 3 1/2".

(3) Place absorbent cotton in center of gauze with 9 3/4" side parallel to 22" side.

(4) Fold 22" edges of gauze over cotton so that they overlap.

(5) Fold each end of the gauze back over cotton. These gauze ends act as "tabs" so that the pad can be pinned to the binder.

Vulva Pads (Not Standard). - For the making of vulva pads, reclaimed or washed gauze is used. The dressing 24" x 18" which has become smaller as a result of shrinkage is used for the cover while absorbent cotton 9" x 4½" and the folded sides of gauze are used as a filler. The thick absorbent cotton is separated in the middle, and the gauze strips inserted like a sandwich. This cotton sandwich is placed in the gauze and the gauze folded over it in the same manner as the gauze is folded in making Dakin's pads.

Vaseline Gauze. - The Carrel-Dakin treatment of an infected wound requires that the skin close to the wound be protected by gauze saturated with vaseline. Many methods of preparing this gauze have been tried. A practical method is as follows:

(1) Cut a 4" bandage into 9" strips.

(2) Place these strips over one another in an oblong metal box, turning back the edge of each strip about half an inch. This allows one to readily remove each sheet individually. Fill the box about half full.

(3) Send the box to the pharmacy to be filled with the following formula:

a. Paraffine 3 parts)
b. Resin 7 parts) melt and pour into box
c. Vaseline 90 parts)

(4) Place the boxes in the autoclave and sterilize them at twenty pounds pressure for thirty minutes.

This not only sterilizes them but also allows all the sheets of gauze to become thoroughly impregnated with the formula. When the gauze is needed, single sheets may readily be removed with a sterile sponge stick.

Large Roll Pack (Standard).- For this purpose the dressing roll gauze may be used. This can be bought 4½" wide and eight ply. A piece 110" long is cut from this roll. A sufficient amount of gauze is unfolded at each end so as to allow for turning in of raw edges. The gauze is again folded and rolled. It is then packed in individual packages doubly wrapped and labeled.

If you wish to use the "Flatfold" bolt of gauze, cut off a piece 118" long:

(1) Place it with 118" side toward you.

(2) Fold each side so as to bring the two selvages to the center.

(3) Fold each 118" side again in half so as to bring each folded edge to the center. (Four ply.)

(4) Fold in the raw edges at either end for about one inch.

(5) Fold the 118" side at the middle making a piece approximately three yards long and four inches wide. (Eight ply.)

(6) Roll, doubly wrap and label.

Leg Roll. - The leg roll is the same as a large roll pack only it is five yards long. For special purposes varying lengths of eight ply four-inch wide rolls may be needed. In such cases the operating room is so notified and they can make the length of dressing necessary.

"Abdominal Packs,""Abdominal Pads"; "Laparotomy Pads." (Standard) - Various kinds of pads, gauze, cloth, rubber, etc., are used to form a non-abrasive wall which will prevent intestines and abdominal or other organs from escaping into the field of operation, and also to maintain body temperature during exposure.

The essential characteristics are:

(1) Proper quality of mesh (gauze) to provide adequate protection for the tissues.

(2) Sterilability.

(3) Ability to retain saline solution.

(4) Freedom from loose threads.

(5) Tensile strength.

(6) Absorbency.

(7) Uniformity of size.

(8) Very soft and nonabrasive.

(9) Taped for forceps, ring or disc.

The gauze used for making these packs should be a closer weave than that used for sponges. The "Standard" type gauze is 20 x 16 mesh. Some hospitals prefer an even heavier mesh.

Four types of standard abdominal packs will be described:

Large Oblong Pack ..... 36" x 8"
Large Square Pack ..... 12" x 12"
Medium Square Pack .... 8" x 8"
Small Square Pack .... 4" x 4"

In making these packs one may either begin by using a nine-inch four-ply dressing roll or by folding cut pieces of "Flatfold" gauze. Both methods will be described. Practically all standard types may be purchased "Ready cut."

Large Oblong Pack (Standard) (36" x 8"):

(1) A 74" piece of 9" four ply dressing roll is laid flat on the table.

(2) This is folded in half, making a piece of gauze eight ply 9" wide and 37" long.

(3) The raw edges are turned in for a distance of about 1".

(4) A piece of tape 1/2" wide, 18" long is looped so as to make a 9" loop.

(5) The two cut ends of the tape are inserted between the cut ends of the dressing roll and all edges are stitched around.

(6) Cross sewing or quilting is done about every 4" of length and width.

OR

(1) From a piece of "Flatfold" gauze cut a piece 74" x 36".

(2) Lay gauze flat with 74" side towards you.

(3) Fold each 36" side towards center making pieces of gauze 36" x 32", two ply.

(4) Fold each folded 36" side again so as to meet at the center, making the pieces 36" x 16", four ply.

(5) Fold 36" side at center, making a piece 36" x 8" and eight ply.

(6) Insert 1/2" wide 18" long looped piece of tape making a 9" loop into corner and stitch around all edges - make cross sewing or quilting every 4" of length and width.

Large Square Pack (Standard) (12" x 12"):

(1) Place a piece of 48" x 24" gauze on a flat surface with 48" side towards you.

(2) Fold 48" side towards you making gauze 48" x 12". two ply.

(3) Fold 12" edge to opposite side, making piece 24" x 12" and four ply.

(4) Twelve inch edge is again folded in the same manner, making a square 12" x 12", eight ply.

(5) All raw edges are turned in and stitched around after inserting the two ends of the 1/2" wide looped tape 18" long.

The gauze is cross stitched and quilted every four inches of length and width.

Medium Square Pack (Standard) (8" x 8"):

(1) Place an 18" piece of the 9" four ply dressing roll flat on the table.

(2) Fold the 18" piece in half and turn in the raw edges for about 1"; this makes the gauze pack approximately 8" x 8", and eight ply.

(3) All edges are stitched around after inserting the two ends of the 1/2" wide looped tape 18" long. The gauze is cross stitched and quilted every four inches of length and width.

OR

(1) Take a flat piece of gauze 32" x 16" and fold the 32" side in half making the gauze 16" x 16", two ply.

(2) Fold the gauze again in the same manner, making the piece 16" x 8" and four ply.

(3) Fold the 8" side to the opposite 8" side making the gauze 8" x 8" and four ply.

(4) Turn in all raw edges and stitch around after inserting the two ends of the 1/2" wide looped tape 18" long. The gauze is cross stitched and quilted every four inches of length and width.

Small Square Pack (Standard) (4" x 4"). -

(1) A 10" piece of the 4½" four ply dressing roll is placed flat on the table.

(2) The cut edges at each end are turned in for about one inch and the gauze is folded in the middle, giving a piece approximately 4" x 4" and eight ply.

(3) All raw edges are turned in and stitched around after inserting the two ends of the 1/2" looped tape 18" long. The gauze is then cross stitched.

OR

(1) Take a flat piece of gauze 16" x 9", place it with the 9" side towards you.

(2) Fold each 16" side towards the center, making the gauze 16" x 4½" and two ply.

(3) The 16" side is now folded in half, making the piece 8" x 4½" and four ply.

(4) This fold is again repeated in the same manner, making the piece 4" x 4½" and eight ply.

(5) All raw edges are turned in and stitched around after inserting the two ends of the 1/2" wide looped tape 18" long.

The gauze is then cross stitched.

Powder Sponges (Not Standard). - Sterile powder sponges have replaced the powder shaker on the glove table because:

(1) The powder frequently does not flow readily from the shaker.

(2) Should the shaker become contaminated every one using it is also contaminated.

To make powder sponges, simply fill the pocket of a 2" x 2" sponge with unscented talcum powder. Place four sponges in a package and wrap doubly. Packages containing only one powder sponge should also be made for emergency use.

All powder sponge packages should be sterilized in the steam autoclave for thirty minutes at twenty pounds pressure. They should not be wrapped in the same packages with the gloves because such long sterilization would spoil the gloves, while a shorter sterilization would not always sterilize the powder. These powder sponges are not discarded after use, but are collected in a small dish near the glove table, are refilled, resterilized and used again.

The glove drum should have ten packages of powder sponges, one for each table set up.

Plaster of Paris Bandages. - The commercial Plaster of Paris bandage on the market is far inferior to the handmade Plaster of Paris bandages.

A crinoline bandage having 32" x 28" threads to the inch is used for impregnation with plaster. It is cut in varying widths, 2-3-4 inches, and is from six to ten yards long. The ends of the bandage are threaded before being impregnated with plaster.

Plaster of Paris is found on the market in two grades, commercial and dental Plaster of Paris. In making Plaster of Paris bandages, dental plaster (fine) is to be preferred because it contains no gritty or foreign substances and hardens quickly. To impregnate the crinoline bandage with the plaster, place a single layer of bandage on a smooth surface and cover it with a large heap of Plaster of Paris. With the hand rub the plaster into all the meshes of the crinoline. The plaster should be smoothly and evenly distributed. Various substitutes for the hand have been tried, but the smoothest and most even impregnation is obtained by the hand distribution of the plaster.

The excess plaster is brushed off and the impregnated bandage rolled loosely, wrapped in paper and placed in an air-tight container (tin canister sealed with adhesive) until used.

Packing. - Packing is made in various widths from 1/4 to 3 inches. The length of the packing varies according to its use. Ward packing e. g., the packing which is on the surgical carriage in each ward, is 1/2 to 1 inch wide and 6 inches long. These are placed in a wide mouth jar with a screw cap; each separated from its fellow by a layer of cotton, so that when the top piece is removed, the next lower piece is still covered by cotton, thus preventing contamination.

Gauze packing which is placed in the drums for use in the operating room is from 1/4 to 3 inches wide and 2 yards long.

In making gauze packing, one takes bandage or sheet gauze four times the width of the desired packing. Each edge is folded in to meet at the middle, and the entire piece is folded down the middle. This gives the desired width of packing of four thicknesses and no raw edges.

This packing may be plain or medicated. The most frequently used medicated packing is iodoform packing. In the preparation of iodoform packing, take the various widths of packing, cut in two-yard lengths, sterilize and then, under aseptic conditions, place the gauze packing in the following solution:

Salt solution with soap suds	Oz.	8)	Giving a 10%
Glycerine	Drams	4)	solution when
Iodoform powder	Drams	7)	finished

After the gauze has become thoroughly impregnated, wring out the excess and place the packing in a glass jar with a screw top, sterilize again in the autoclave and store away until wanted. Medicated packings are being used less and less.

Packing may be purchased ready made. Most manufacturers produce a "Selvage gauze" which is a specially woven fabric having a selvage on each side and is made in widths from 1/4" to 2". This is one-ply gauze and comes in 100-yard rolls - unsterilized or 5-yard rolls sterilized in bottles. The 100-yard pieces are all plain gauze. However, the 5-yard sterile piece may be obtained plain or iodoform impregnated.

One may also obtain 8-ply rolls of 2" x 7" or 1" x 54" ready made.

Reclaimed Gauze. - The amount of gauze used in any hospital is tremendous. It forms one of the largest items of expense in the care of surgical patients. To reduce this expense, somewhat, gauze is used more than once. When the dressings are removed from a patient in the ward or room, they should be placed in a pail containing a 2% solution of lysol and allowed to remain there for 24 hours. This sterilizes the dressings. At the end of this period, the lysol is drained off, and the wet dressings are sent to the laundry, where they are washed in a machine. From the laundry, they come back to the operating room in large bags. These bags are put in the autoclave for 30 minutes under 20 pounds pressure for a second sterilization. They are then given to the operating room attendants, who pull them (flatten them out), assort them as to size and make sponges and dressings from them. These sponges and dressings are smaller than the regular dressings and are placed in the ward dressing drums to be used as ward sponges or they are sent to the dispensary for use.

Gauze bandages cannot be reused very well, but all muslin bandages can be used again. These are treated the same as the flat gauze.

Chapter III

CARE OF INSTRUMENTS

All instruments must be kept clean, dry, and in perfect working order. To do this requires constant care.

After an operation is finished, all the instruments are allowed to soak in cold water (to remove the blood). The sharp instruments are removed first and cleaned. The routine for cleansing is as follows:

(1) Allow to soak in cold water and remove blood.

(2) Wash thoroughly in hot soapy water to which is added a little ammonia.

(3) Scour with Bon Ami to remove spots.

(4) On all instruments with teeth use a stiff brush and carefully clean out the crevices.

(5) All jointed instruments, that can be taken apart, are separated.

(6) After cleansing, all instruments are boiled.

(7) They are then dried and placed on a table, preferably over a radiator (to become absolutely dry).

(8) All instruments, whose parts have been separated, are reassembled. In order to be sure that the correct parts are together, the numbers on each part should be compared.

(9) All jointed instruments should have a drop of "3 in 1" Oil placed at the lock or joint.

(10) Any instrument not in perfect order, is placed in the repair box. All other instruments are returned to their respective places on the shelf.

SPECIAL INSTRUMENTS:

Scalpels.--After every operation, all scalpels are resharpened by the orderly on a fine oil-stone. After honing, the knife is stropped on a good leather strop, using a motion the reverse of the one used on the stone. This, of course, is not necessary where removable blades are used.

STERILIZATION.--Recently at the French Hospital we have been boiling our knives for three minutes. Occasionally boiling removes the edge of the knife. To prevent this, knives may be placed in pure carbolic acid for two minutes, and then in 60% alcohol for ten minutes.

SURGICAL NEEDLES.--Surgical needles are "put up" in packages and sterilized in the autoclave. The types of needles vary with different operators and with different operations. After use the needles are washed, scoured with Bon Ami and sharpened in an emery bag. They are thoroughly dried, repacked and sterilized.

HYPODERMIC NEEDLES.--After use all hypodermic needles should be thoroughly washed with cold water, and dried by passing a small quantity of alcohol through the needle and sucking air back and forth until the alcohol has evaporated. A drop of alboline is allowed to flow through the needle before replacing the wire. This wire is not removed until the needle is about to be used. If a hypodermic needle becomes plugged, the plug may occasionally be forced out of the needle in the following way:

(1) Half fill the syringe with water.
(2) Attach the needle.
(3) Keep a continuous pressure on the piston of the syringe forcing the water into the needle.
(4) Heat needle red hot over an alcohol flame--frequently before the needle becomes red hot the plug will have been forced out and the water will go through nicely.

The bevel of the large bore aspirating needles may be sharpened on an oil-stone. The smaller needles when they become dull should be discarded.

STERILIZATION.--Hypodermic needles may be boiled (do not remove the wire until after boiling)--or they may be wrapped individually or in packages of two and sterilized in the autoclave.

A good method of keeping and sterilizing hypodermic needles is to place them in a small glass tube open at both ends and to plug each end of the tube with cotton. These tubes may be sterilized in the autoclave.

SYRINGES.--All syringes should be taken apart immediately after use. They should be thoroughly washed, cleaned and dried. They may be dried by using cotton on the end of an applicator or a small quantity of alcohol may be sucked into the syringe, ejected, and the syringe dried by sucking and expelling air.

If the syringe has not been taken apart after use the piston may become "fixed"; in that case, some difficulty may be experienced in dislodging it. A method which has been rather successful in our hands has been to take a syringe with a fine needle and introduce the needle into the "fixed" syringe through the nipple; aspirate as much of the fluid as possible and wash out the cavity with cold water by injecting and aspirating as often as necessary. Following this, inject Antiformin into the space and allow the syringe to soak in a solution of Antiformin over night. In the morning the syringe should come apart very easily. Boiling the syringe in glycerine will occasionally dislodge a fixed syringe when all other methods fail.

STERILIZATION.--All glass or metal and glass syringes during sterilization should not have the piston in the barrel. The expansion of the two structures under heat varies and may crack the barrel of the syringe.

All glass syringes should be placed in cold water and then boiled. The sudden expansion caused by introducing a syringe into hot water causes it to crack.

Always ask the operator for permission, before boiling a syringe in soda solution, because syringes boiled in a soda solution cannot be used for spinal anesthesia, transfusion, etc. The soda solution neutralizes the novocaine and in transfusions may be the cause of severe reactions.

Syringes may be sterilized in the autoclave. Before sterilizing any syringe always compare the number on the piston and barrel and be sure they correspond. The piston and barrel are wrapped separately in gauze. They are then doubly wrapped in muslin, labeled, and sterilized in the autoclave.

RUBBER GOODS.--The care of rubber gloves has been discussed. All rubber articles after use must be thoroughly washed in cold soapy water.

STERILIZATION.--For sterilization we divide rubber goods into hard and soft. (Hard rubber,--pessaries, hard rubber syringes, hard rubber or vulcanized razor handles; Soft rubber,--tubing, fountain syringes, rubber bandages, rubber dam.) None of the hard rubber instruments should be boiled. They should all be sterilized by immersion in 5% carbolic acid or bichloride 1-5,000 for two hours.

Soft rubber articles may be boiled. Frequent boiling softens the rubber. Never boil metal instruments and soft rubber together in the same container as the instruments may become discolored.

CATHETERS AND BOUGIES.--Soft rubber catheters may be boiled. The silk woven catheters or bougies should never be boiled. They should be washed with cold soapy water and then immersed in cold bichloride solution 1-5,000 for two hours.

CYSTOSCOPES.--These should be sterilized by immersion in a 5% carbolic acid solution for fifteen minutes, after which the surface is washed with saline or alcohol.

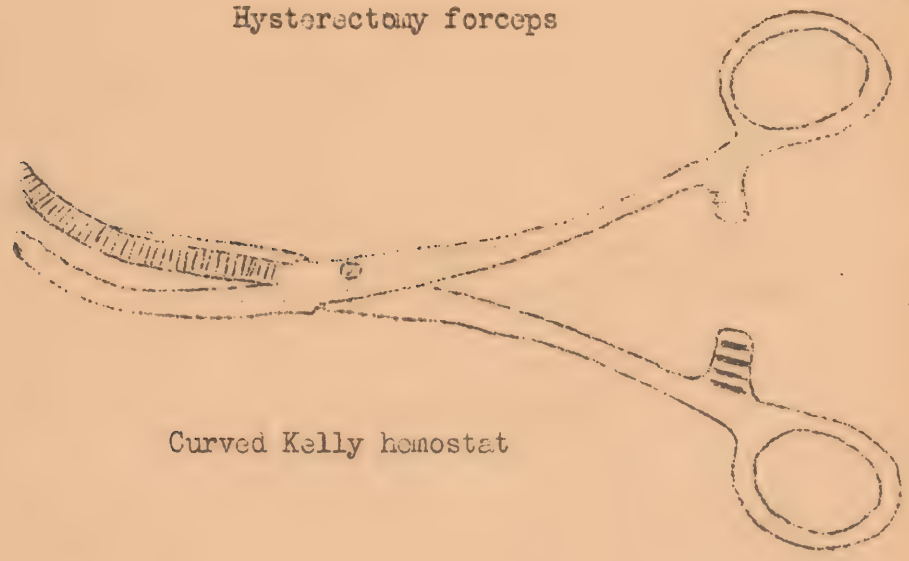
After use, these instruments are again sterilized by immersion in 5% carbolic acid and washed in alcohol. All parts must be thoroughly dried. To dry the canal of the cystoscope, pour alcohol through it, and dry it with a piece of absorbent cotton on a long metal probe.

URETERAL CATHETERS.--These are silk woven and shellacked; they should never be boiled or placed in or near a hot solution, as this softens them. They should be stored in a cool, dry place.

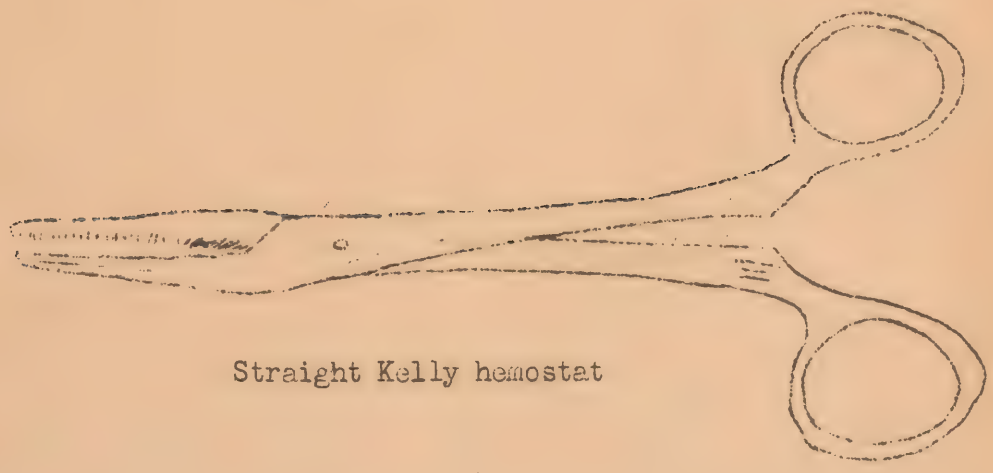
After use, they should be washed with boric acid inside (using a syringe to force solution through) and out. They may be sterilized by immersion in 5% carbolic or 1-5000 bichloride.(cold) or by suspension in a vessel containing formaldehyde fumes

ELECTRICAL INSTRUMENTS.--All electrical instruments, cauteries, etc., in the operating room should be tested, before every operation in which they may be used, so as to be sure they are in working order.

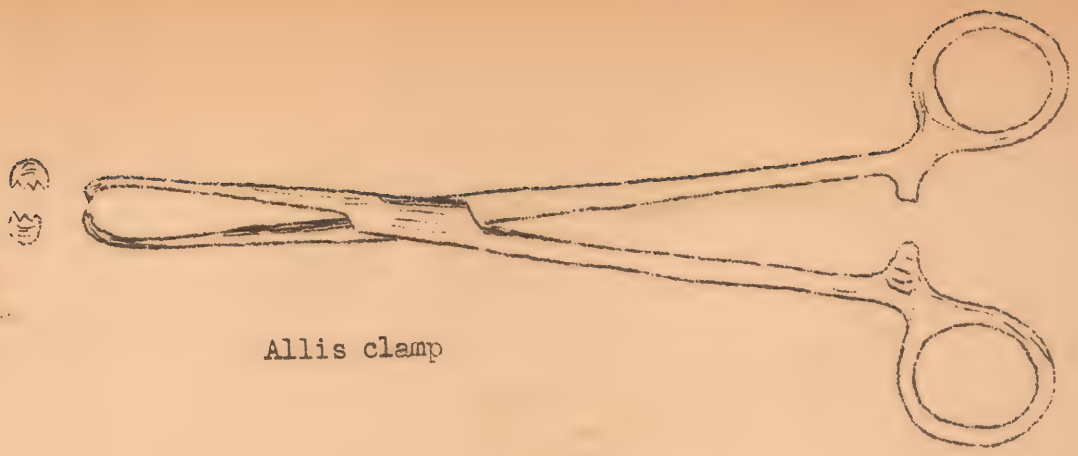
Hysterectomy forceps



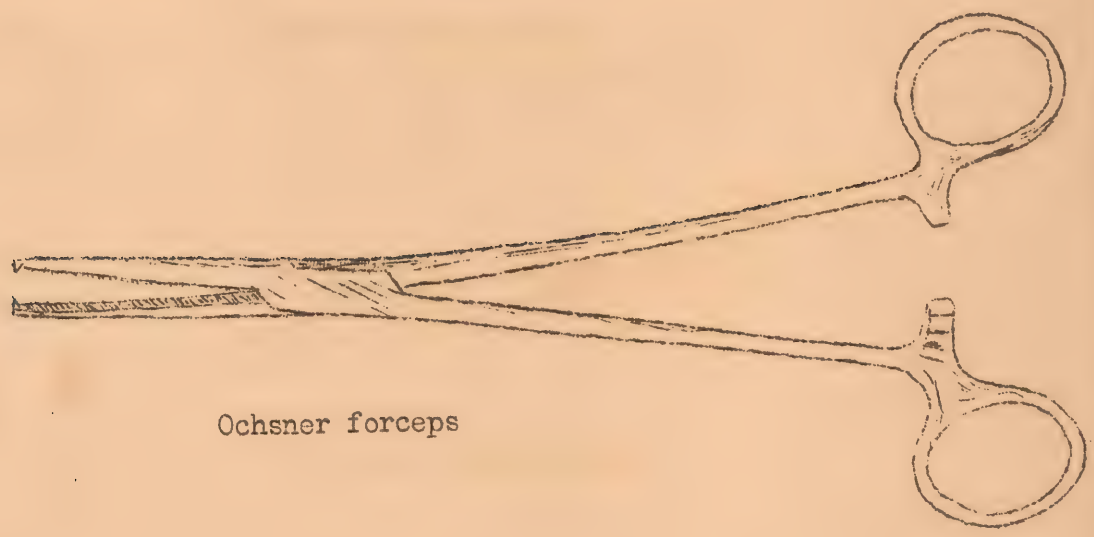
Curved Kelly hemostat



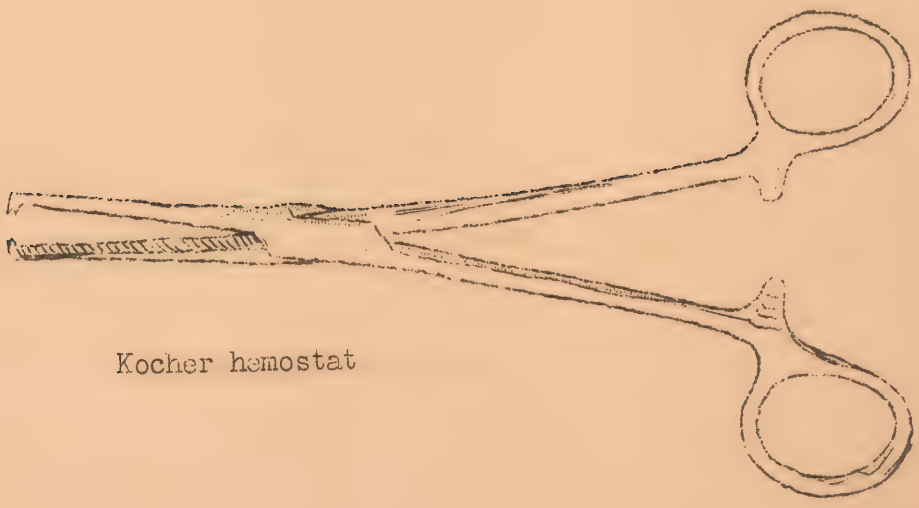
Straight Kelly hemostat



Allis clamp

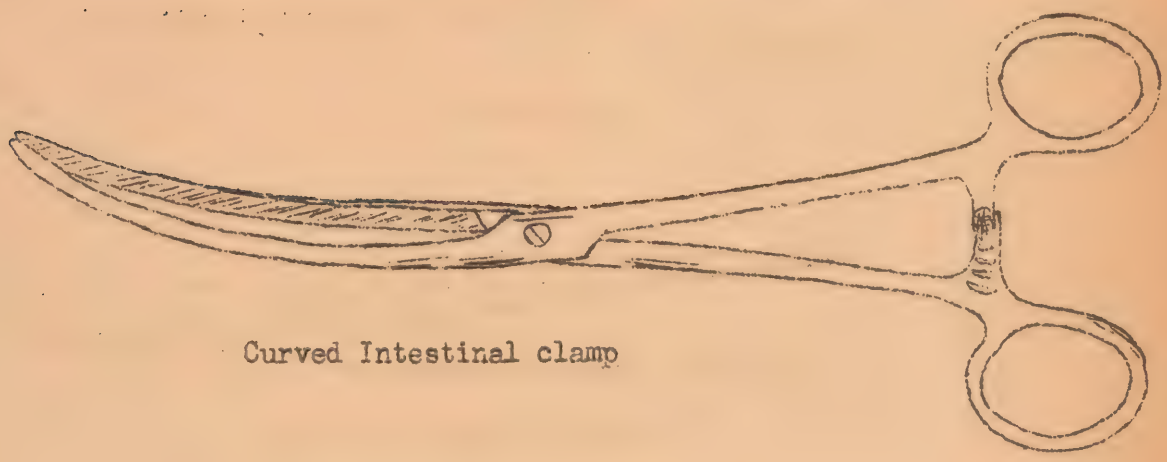


Ochsner forceps

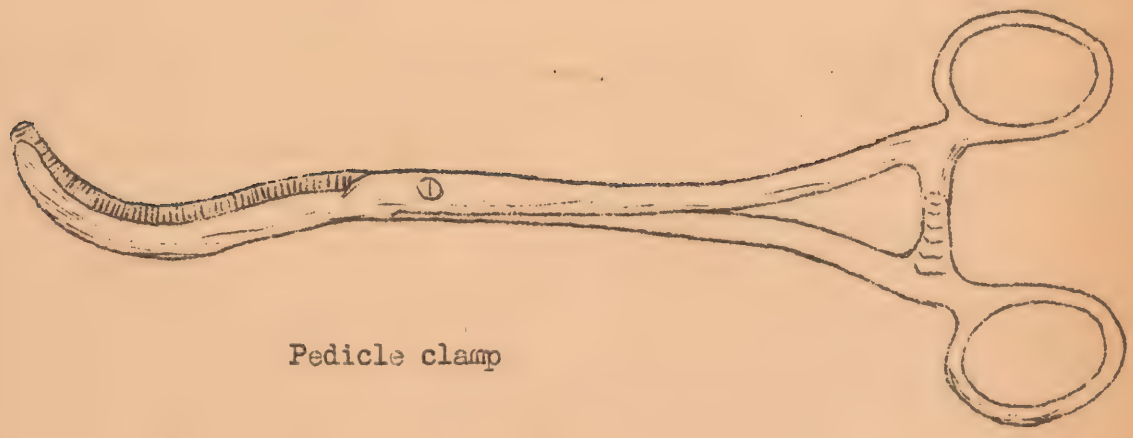


Kocher hemostat

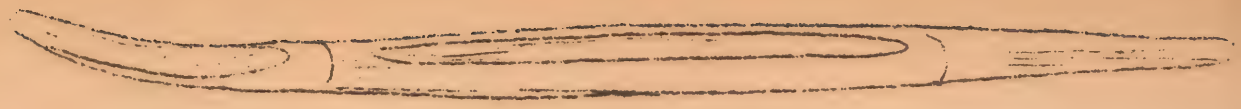
Straight Intestinal clamp



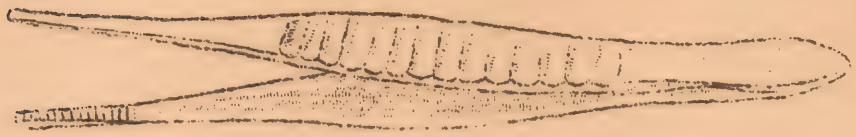
Curved Intestinal clamp



Pedicle clamp



Periosteal elevator

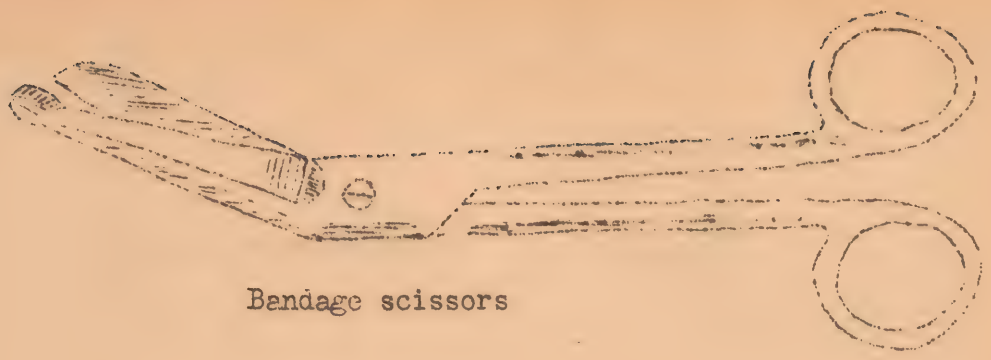


Thumb forceps

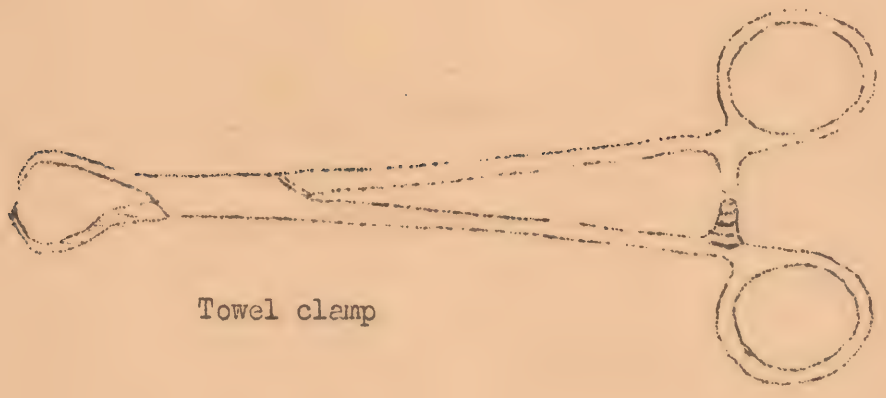
Thumb forceps, rat toothed

Bard-Parker knife handle

Bard-Parker knife blades

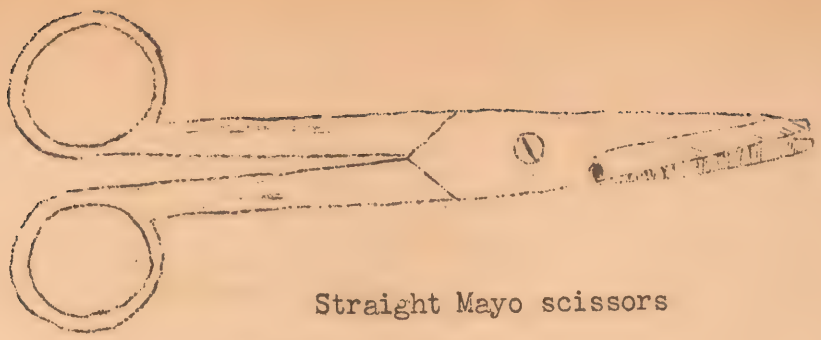


Bandage scissors

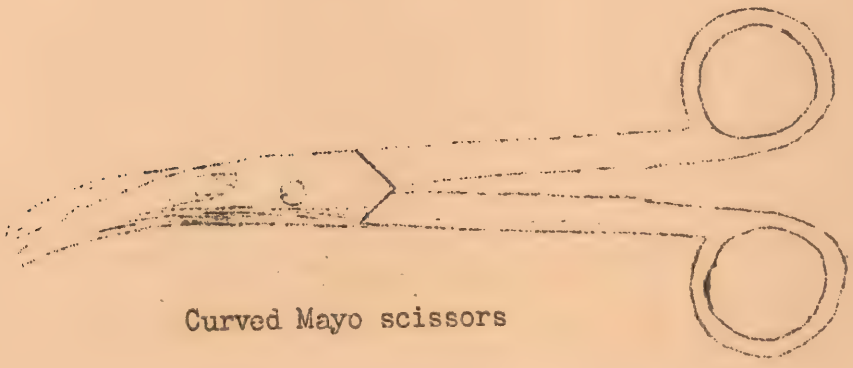


Towel clamp

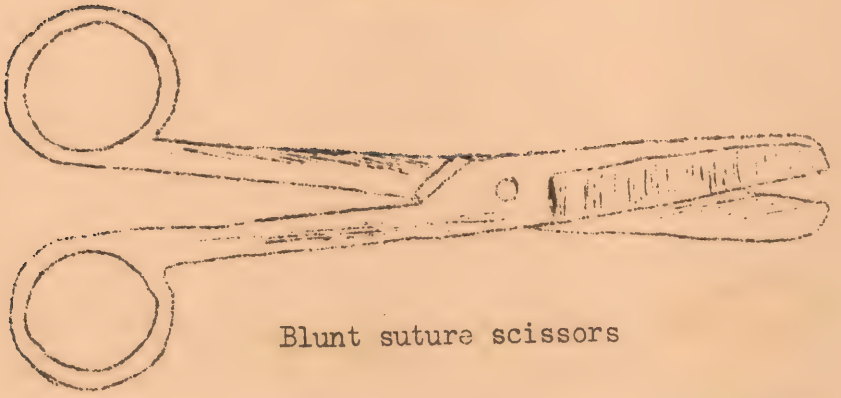
Sponge forceps



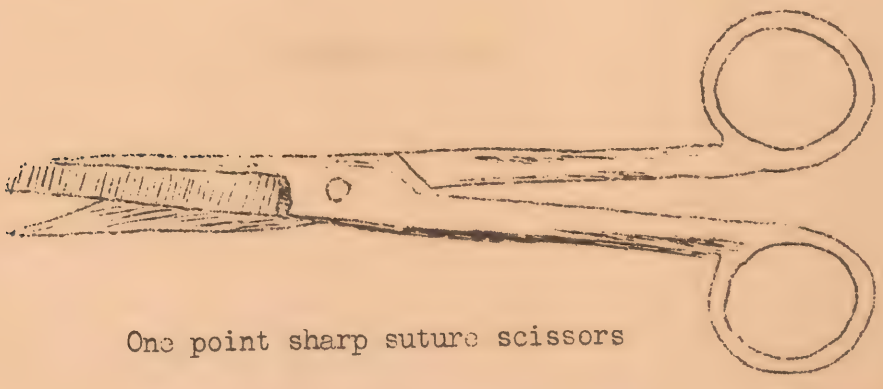
Straight Mayo scissors



Curved Mayo scissors

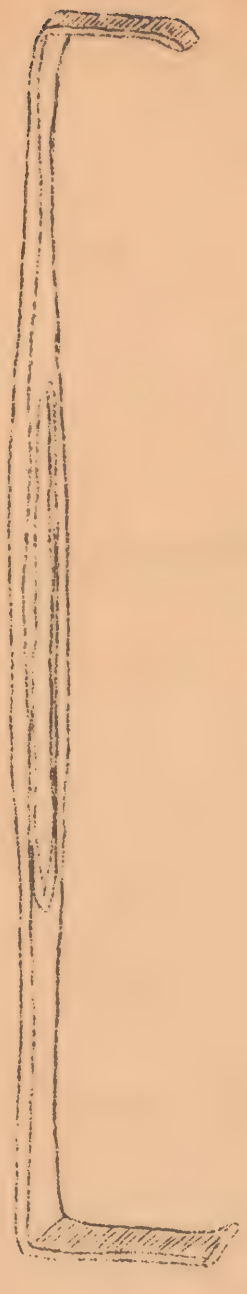


Blunt suture scissors

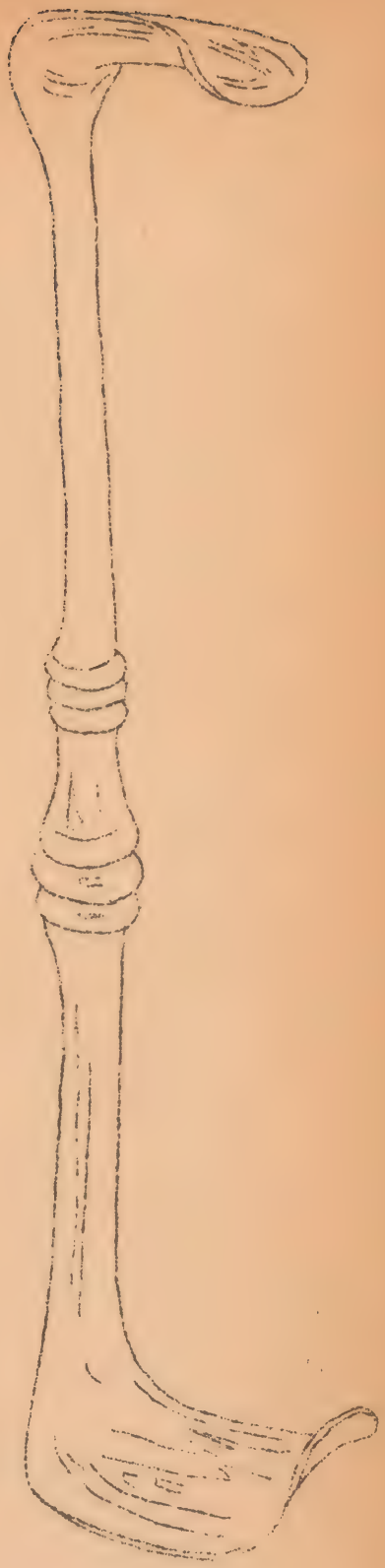


One point sharp suture scissors

Sharp Retractor



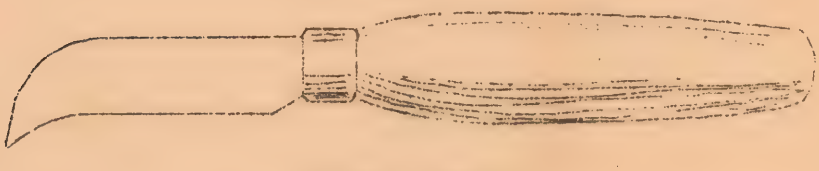
Army
Retractor



Abdominal Retractor

Grooved director

Needle eye probe

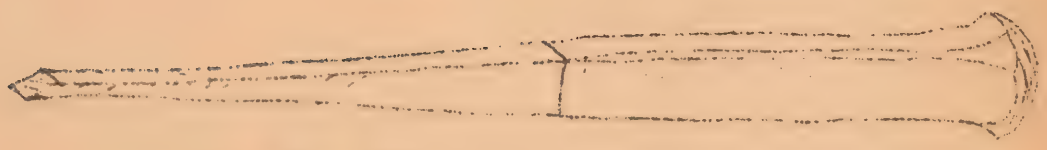


Plaster knife

Bone holding forceps

Sound

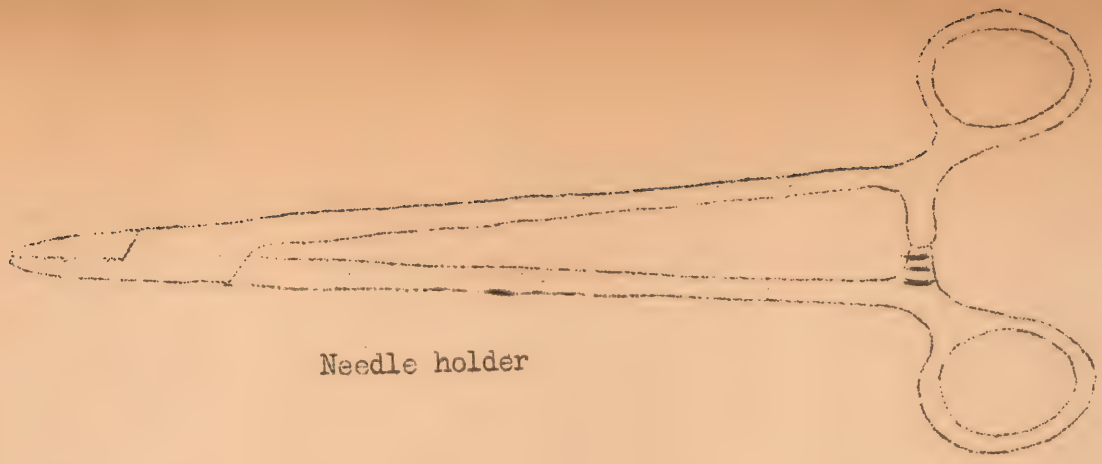
Osteotome



Bone chisel

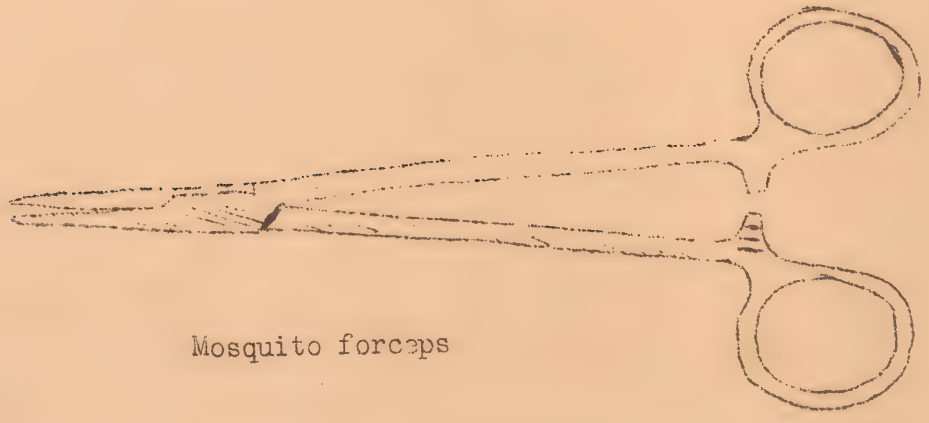
Bone gouge

Bone curette



Needle holder

Bone rongeur



Mosquito forceps

Chapter IV

GLOVES

The use of rubber gloves is a relatively recent refinement of surgery. Dr. W. S. Halstead of Baltimore, in 1889, was the first one to advocate their use. The gloves he used were heavy, seamed gloves and rather ill-fitting. It was some time before surgeons generally adopted them, as they claimed the gloves interfered with their sense of touch. At the present time, with the improvement in the manufacture of gloves, making them thinner and seamless, their use has become practically universal. Ordinary rubber gloves are made by dipping a porcelain-shaped form into rubber cement. This cement is produced by dissolving crude rubber in naphtha or benzine. The form is dipped from 5 to 8 times and dried between each dipping, after which the rubber is toughened or cured by contact with an acid vapor.

In wearing rubber gloves, asepsis is assured, because gloves can be boiled or sterilized by steam. Some men have aptly called it "the boiled hand." In "scrubbing up," the surface of the hand is sterilized; during the operation the hand perspires and the perspiration may bring some bacteria from the bottom of the sweat glands to the surface. Rubber gloves keep these organisms from the patient. Gloves are ordinarily worn to protect the patient, not the operator, and should not be used as an excuse for insufficient "scrubbing up." One never knows when a glove may be punctured or torn during an operation. Therefore, if the hand has not been properly prepared, a "dirty" hand would come in contact with the operative field.

There are two methods of preparing rubber gloves for use:

1. Dry.

2. Wet.

DRY METHOD

In this method, the gloves, after being washed, dried, and thoroughly powdered, are wrapped in a towel and sterilized, by steam, under fifteen pounds pressure for fifteen minutes and followed by ten minutes in the vacuum. If sterilized for a longer period than this, the rubber will spoil. After the steam sterilization is finished, the gloves are removed from the sterilizer and allowed to dry in the air. (This prevents the rubber from sticking). There has recently appeared on the market a form of glove made by a new process using elastic gum (Latex) and electricity by which method they have produced a glove which is apparently better able to withstand the heat and number of sterilizations.

METHOD OF PREPARING GLOVES FOR DRY STERILIZATION.

A towel or piece of cloth 20" X 20" is placed on a flat surface. Two gloves of the same size and in the same condition of repair are taken, and the wrist pieces folded back for a distance of 2 inches. (This is to allow the surgeon to grasp the glove, when putting it on, without touching the outside). Some institutions recommend the insertion into the hand of the glove of a pad of gauze about 8 layers thick. This pad should be as wide and as

large as the palm of the glove, the purpose being to allow the steam to get into finger tips for sterilization.

1. The two gloves are placed on this cloth so that the wrist pieces are about 4 inches from the lower edge with the thumbs up and the right glove on the right side. The gloves should lie about 2 inches from each other and about 5 inches from the side of the cloth.

2. Fold up bottom edge as far as possible without bending the gloves.

3. Fold in each side to completely cover glove.

4. Fold in the middle, closing the glove book.

5. Fold the cloth downward from just above the tips of the fingers.

The glove book must be completely covered by another towel before it is sterilized. This towel should be about 12" x 24".

1. Place the towel with the 12" side toward the person folding it.

2. Place the glove book on the towel 3 inches from the end and at an equal distance from both sides.

3. Fold 3 inch edge over glove book.

4. Fold in both sides.

5. Fold down top and tuck edge in pocket.

6. Mark size and condition of the glove on the outside of the package. A good way to mark them is:

New gloves, size 8 is marked "8".

One or two repairs, size 8 is indicated "8 +"

Several repairs, size 8 is marked "8 + +" or "8 Ward."

Another method of putting up dry gloves, is to have a cloth book with two pockets, one on each side and two tapes at each edge. Each packet should be about 11" x 6". The gloves are placed in their respective pockets, marked right and left. The book is closed and the tapes are tied--there is no outside cover made but the outside of the book is marked as to size and condition of contents. The first method seems to be the better of the two--the chances of contaminating the gloves seem less.

Individual 2" x 2" powder envelopes may be placed either in the glove book or, they may be sterilized in separate packages. In some institutions a powder can is used. This is a sifter can with large holes. The can is wrapped in a towel and sterilized in the autoclave for from 20 to 30 minutes. It is then removed and allowed to dry in the air. If the powder is dried in the autoclave it becomes lumpy. This method is not advocated for operating room use, because, should the operator or one of the assistants break his

technic and "dirty" the outside of the can, everyone using the can after him becomes "dirty."

WET METHOD OF STERILIZING GLOVES:

1. Pick out two gloves of the same size and condition--wrap them in gauze or tie them together.

2. Drop the gloves into boiling water.

3. Allow them to boil for five minutes, then transfer them to a cold solution of weak bichloride, 1-10,000 or lysol 1% until used.

Precautions:

a. If gloves are boiled with the instruments, see that there are no sharp points near them and that there is no "soda" in the water.

b. See that water completely covers the gloves--white spots appear on the gloves above the water line.

c. Do not put the gloves into the water until it boils. Rubber deteriorates very rapidly in hot water.

TECHNIC OF PUTTING ON GLOVES. -- DRY METHOD.

1. The gown is put on.

2. The hands are thoroughly dried.

3. The hands are thoroughly powdered.

4. Grasp turned back cuff of right hand glove with the left hand.

5. Place right hand in glove, pulling it on well. If hand is dry and back of hand well powdered, it slips in readily. Do not touch outside of glove with ungloved hand.

6. Place gloved fingers of right hand underneath cuff on left glove.

7. Place left hand in glove and pull it on.

8. If the gown has stockinet wristlets, place the cuff of the glove over it. If the cuffs of the gown are not ribbed, pull the cuff taut, fold it over itself at the wrist and turn back the cuff of the glove so as to hold the sleeve of the gown.

WET METHOD

1. Take pair of gloves of the proper size and remove the gauze.

2. Fold back the cuff of the glove--being careful not to touch the outside of the glove.

3. Hold the glove at the wrist and draw it through the solution so as to fill all the fingers with fluid.

4. Grasp the folded back cuff of the right glove with thumb and fingers of the left hand, and pull the glove on the right hand, pushing the fingers well into the tips of the glove, displacing the solution. (Some men put glycerine on the hands to make the glove slip on more easily).

5. Make a fist with the gloved hand--lift the wrist portion of the glove first on the palm side and then on the back, so as to allow all the solution to run out.

6. The left glove is put on the same way. Be careful not to touch the gloved hand with the bare hand. In using the wet glove technic, the gowns are put on after the gloves, thus avoiding wet sleeves.

In some clinics, the nurse holds the glove for the operator. In that case, she places the fingers of both hands under the folded back portion of the cuff and stretches the mouth of the glove by pulling her hands apart. The surgeon, after powdering his hand thoroughly, pushes it into the glove as far as he can, the nurse then reflects the cuff over the wrist of the gown which the surgeon has adjusted. In helping the surgeon on with his gloves, always be careful, first, to have the correct glove for the hand, and second, to have the thumb pointing in the right direction.

CARE OF RUBBER GLOVES:

1. All gloves should be thoroughly washed in cold water before being removed. (This should be insisted upon in every operating room).

2. After removal all gloves are again washed inside and out with cold water and soap by the nurse.

3. All gloves are wrapped in a piece of muslin and boiled for five minutes. (Muslin is used to keep the glove from sticking to the sides of the sterilizer).

4. After boiling, the gloves are lifted out of the sterilizer and the water drained off. They are removed from the muslin package and hung on a glove tree to dry, placing a prong of the tree into one finger of each glove. If there is no tree, the gloves may be hung over cloth covered rods stretched across a drying closet (small steam heated room).

5. When the gloves are dry on the outside, they are turned and allowed to dry on the inside.

6. When dry, they are sent to the work room to be repaired, powdered and put up in labeled packages.

REPAIRING GLOVES

Holes in gloves are located by distending the glove with air and holding it close to the face. In that way the escaping air may be both felt and heard. If necessary, a drop of water may be placed over the doubtful

spot and bubbles looked for.

Technic of repairing gloves:

1. Grasp glove at both sides of the wrist with thumb and index fingers.

2. Twirl glove so as to close off wrist and catch all the air in the glove.

3. Push the air into one of the fingers and listen for its escape. When a hole is located, turn the glove inside out and introduce a test tube into the finger. This stretches the opening. Clean the rubber of the glove around the opening with benzine. Roughen the rubber slightly with a nail file or sand paper. Apply any good rubber cement around the opening and cover it with a patch, pressing it on firmly for a few moments.

Patches are cut from the good rubber portion of old gloves using a circular carpenter's punch of varying sizes. Gloves that are patched should be so labeled. The patches should always be placed on the inside of the glove so that they cannot be lost in the wound. No patched gloves are to be used in the operating room.

Methods of applying powder to the gloves.

To powder gloves before wrapping them in packages.

1. Place a large quantity of unperfumed talcum powder in a large flat basin.

2. Arrange the gloves in pairs.

3. Take each glove singly and push it down on the powder so that a thin coating remains on the entire glove.

4. Turn the glove inside out and repeat step 3.

In this way the entire glove is thoroughly and evenly powdered without leaving a large quantity at the finger tips. After thoroughly powdering the gloves, make sure that all the patches are on the inside.

COTTON GLOVES

Some men, when handling intestines or during an operation where supertechnic is used, wear white cotton gloves. These are put up in pairs and wrapped in a double package, labeled and sterilized in the autoclave. They are worn over the rubber gloves; several pairs should be ready so that they can be frequently changed.

GLOVE "POINTERS"

1. During the course of an operation, the gloves should be washed frequently in a clean solution.

2. Always wash your gloves before taking them off.

3. Always have the patches on the inside.

4. If glove fingers are too long, take a wet sponge and pull the fingers down so that the excess of rubber collects at the base of your fingers and not at the tips.

5. In preparing the Operating Room for an operation, the nurse may wear two pairs of gloves. As soon as she has set up her tray, made her suture book, draped the patient, etc., she removes the outer gloves and is "clean" for the operation.

6. Change gloves immediately if they become torn or contaminated.

7. Never boil gloves in soda solution with instruments.

Chapter V

OPERATION OF THE AUTOCLAVE

Start With All Valves Closed.

Before operating sterilizer always check water level in generator. Open WATER SUPPLY VALVE and fill generator to within approximately 1 inch from top of gauge glass. Never allow water level to fall below bottom of gauge glass.

To sterilize dressings, packs, drums, etc., turn PRESSURE REGULATOR to "HIGH".

To sterilize rubber goods, solutions, instruments, utensils, etc., turn PRESSURE REGULATOR to "LOW".

(When properly adjusted, the PRESSURE REGULATOR should maintain approximately 18-20 pounds pressure, 255-259 degrees F. at the "High" setting; and approximately 15 pounds pressure 250 degrees F. at the "Low" setting).

1. Light burners under generator.

2. Place materials in sterilizing chamber, taking care to distribute the load so that steam will circulate freely and penetrate the packs. Close door and tighten handwheel. Unnecessary tightening will shorten the life of the gasket. See that VACUUM BREAKER on door is closed.

3. When 15-20 pounds pressure is indicated on JACKET GAUGE, open VACUUM VALVE, then STEAM IN CHAMBER VALVE. A few seconds of this setting is all that is necessary. Shut off Vacuum Valve and allow pressure to rise.

4. Pressure in sterilizing chamber will now rise to level set by PRESSURE REGULATOR. When the CHAMBER GAUGE reads the same pressure as is set by the PRESSURE REGULATOR, the timing period may start.

5. When sterilizing period has been completed, open VACUUM VALVE, and close STEAM IN CHAMBER VALVE. Pressure in the sterilizing chamber will drop until a vacuum of 5-10 inches or more is indicated on the CHAMBER GAUGE. Maintain this vacuum for 5 to 10 minutes, according to size and density of load, to dry dressings.

6. Close VACUUM VALVE. Open VACUUM BREAKER to relieve any vacuum which would prevent opening of the door.

7. When CHAMBER GAUGE indicates zero pressure, open door approximately 1 inch beyond door collar. Leave door in this position for a few minutes to further dry dressings.

8. Before sterilizing another load refill generator. Then repeat process.

9. When through sterilizing for the day, TURN OFF BURNERS.

CAUTION: In sterilizing solutions DO NOT draw a vacuum at any time. After the sterilizing period has been completed, turn off BURNERS and leave all valves exactly as they were, allowing the sterilizer to cool down gradually. Do not open doors until CHAMBER GAUGE indicates zero pressure.

RECOMMENDED EXPOSURES FOR VARIOUS MATERIALS

Timing of the sterilizing period must not start until THERMOMETER reads 240 degrees F.

Dressings, Drums etc.--- 30 minutes with PRESSURE REGULATOR at "HIGH"
Solutions in Flasks ---- 20-30 minutes with PRESSURE REGULATOR at "LOW"
Rubber Goods ---------- 15 minutes with PRESSURE REGULATOR at "LOW"
Instruments ----------- 15 minutes with PRESSURE REGULATOR at "LOW"
Utensils -------------- 15 minutes with PRESSURE REGULATOR at "LOW"

GENERAL RECOMMENDATIONS

a.
Section I ------- Surgical Dressings
Section II ------ Linens, Gowns, etc.
Section III ----- Surgical instruments
Section IV ------ Utensils
Section V ------- Rubber Gloves
Section VI ------ Talcum Powder
Section VII ----- Vaseline
Section VIII ---- Milk
Section IX ------ Saline Solutions
Section X ------- Glucose Solutions
Section XI ------ Distilled Water, Sodium Citrate, and other solutions
Section XII ----- Blood Serum

SECTION I - SURGICAL DRESSINGS

PACKAGES: The packages of dressings should be wrapped loosely. The tightness with which they should be rolled depends entirely upon the nature of the material. Closely woven material, such as toweling, must not be packed and rolled as tightly as gauze or any loosely woven goods. Each package, when completed, must be wrapped carefully in at least two layers of muslin so that no part of the enclosed dressings is exposed. This makes it possible to handle the dressings after they have been sterilized without the danger of contamination.

SIZE OF PACKAGES: The size of the package will vary, depending upon the nature of the goods with which the package is made, and also upon the size of the sterilizer in which it is to be sterilized. Naturally, closely woven goods must be made into smaller packages than porous or loosely woven materials. For best results packages should not exceed 4" in thickness.

CHECKING STERILITY: A check should be made after the sterilizing period is completed, by means of bacteriological test, a self-recording thermometer, or other recognized controls. The thermometer or control should be placed

in the center of the largest package located as near as possible to the center of the load. This precaution will determine if the necessary temperature has penetrated to the center of the dressings. In case the required temperature has not been reached, it will be necessary to resterilize the dressings for a longer period of time.

LOADING THE STERILIZER: Care should be exercised when packing the sterilizer. Place the bundles on edge thus allowing the steam to get between the bundles and penetrate them. Under no circumstances should the dressings be wedged in by force. The same precaution must be taken in packing dressings in dressing containers. It is advisable to pack the dressings so that they will not touch the door when it is closed.

ELIMINATION OF WET DRESSINGS: Many troubles frequently encountered with wet dressings after sterilization of dressings may be overcome largely if the following procedure is carried out. After the door of the sterilizer has been closed and securely locked, allow the dressings to become thoroughly warmed through before any steam is turned into sterilizing chamber from the steam jacket. If this procedure is not followed, the cold dressings will condense large quantities of steam and become so completely soaked with the water of the condensation that it will be practically impossible to dry them by the method ordinarily used in drying dressings; on the other hand, if this procedure is followed, and the dressings are allowed to become well heated, the initial condensation will be reduced to a minimum and the dressings are apt to be dryer when removing them from the sterilizer. This is especially necessary if the steam supplying the sterilizer comes from a line in which it is difficult to remove the condensation.

Wet dressings may also be caused by the failure of the condensation ejector to work properly. If the strainer in the bottom of the chamber should become filled with dirt or threads, the condensed steam will not be removed properly by the ejector, and the moisture will be retained in the chamber. This strainer should be removed periodically and carefully cleaned. Failure to do this may possibly cause faulty sterilization. See Directions No. 171 for further information.

SECTION II - LINENS, GOWNS, ETC.

Linens, gowns, etc. should be wrapped and sterilized following the same general procedure as outlined for Surgical Dressings, Section I. Heavy Linens will require more drying time than light dressings.

SECTION III - SURGICAL INSTRUMENTS

PREPARATION OF INSTRUMENTS FOR STERILIZATION: After surgical instruments have been used in an operation, or in connection with any surgical wound, they should be thoroughly scrubbed with green soap and lukewarm water, taking special care to clean out effectively all joints, grooves, or other places on the instruments which may harbor blood or adhering body tissue. After this is done, they should be thoroughly rinsed in a hot solution of Lysol, one percent.

The instruments should then be boiled in plain water for a period of 3 minutes after which they should be carefully dried and polished and then

put away in the instrument case. All dulled instruments should be sharpened before they are put away.

If the instruments have been used in infected cases, they should first be soaked for about one hour in a warm solution of Lysol, one percent. This is a precaution for protecting the nurses who are to prepare the instruments for sterilization.

STERILIZATION OF INSTRUMENTS IN AN AUTOCLAVE OR HIGH PRESSURE INSTRUMENT STERILIZER: The following method has been found to be very effective: The instruments to be sterilized should be placed in muslin rolls that are made specially for this purpose with loops and flaps. After the instruments have been placed in the loops and the flaps thrown over them, the muslin holders should be rolled up loosely (not tightly). The rolls of instruments should then be placed in the trays provided, and the trays put in the sterilizing chamber. The door of the sterilizer should then be closed steam tight, a vacuum drawn, and the instruments sterilized for a period of 10 minutes with high pressure steam at a temperature of not less than 250 degrees. After this has been done and a vacuum of from 8 to 10 inches has been drawn, and maintained for a period of 10 minutes, the instruments should be allowed to remain in the sterilizing chamber for a few minutes with the sterilizer door standing slightly open. This procedure will insure the instruments being practically dry upon removal from the sterilizer. Having the instruments wrapped in rolls which are sterilized at the same time the instruments are sterilized eliminates the necessity of having sterile towels in the operating room on which to lay the instruments, and the flaps on the rolls when thrown over the instruments and kept over the instruments will prevent any danger of air contamination.

The instrument rolls may be made of heavy muslin and should be made at least one inch wider than the longest instrument to be put into them and of sufficient length to insure each instrument being covered by at least two layers of muslin. There should be a row of loops down the center of the roll for holding and separating the instruments. To each side and to one end of the roll, there should be flaps of such width that when they are folded over the roll, the instruments in the loops will be completely covered.

SECTION IV - UTENSILS

PREPARATION OF UTENSILS FOR STERILIZATION: After utensils have been used in an operation, or in connection with any surgical wound, they should be thoroughly washed with green soap and water. Following this, they should be washed in a one percent solution of Lysol, rinsed in lukewarm water, and dried. If the utensils have been used in infected cases, they should first be soaked for about one hour in a warm solution of Lysol, one percent. This is a precaution for protecting the nurses whose duty it is to prepare them for sterilization.

STERILIZATION OF UTENSILS IN AN AUTOCLAVE OR HIGH PRESSURE UTENSIL STERILIZER: Each utensil to be sterilized should be cleaned and then wrapped in a piece of muslin or gauze so that the entire utensil will be covered by at least two layers of the wrapper. This will insure steam contact with all surfaces of the utensil during the sterilizing period and will also be of service in handling the utensil after it is sterilized. When the utensils are packed in-

to the sterilizing chamber, care should be exercised to place them on edge, or with the bottom side up. The drying of the utensils will then be a simple matter since all of the condensation forming on the sides of the utensils will easily drain into the bottom of the sterilizer. A basin or other utensil should never be placed over the opening in the back of the sterilizer through which the steam enters the sterilizing chamber. The utensils should be stacked in the chamber with their edges turned toward this steam port. When the packing of utensils in the sterilizing chamber has been completed, the door of the sterilizer should be closed steam tight, a vacuum drawn, and the utensils sterilized for a period of 20 minutes with high pressure steam at a temperature not less than 250° F. After this has been completed, and a vacuum of 8 to 10 inches has been drawn and maintained for a period of 10 minutes, the utensils should be allowed to remain in the sterilizing chamber for a few minutes with the sterilizer door standing slightly open. This procedure will insure the utensils being practically dry when they are removed from the sterilizer. Having the utensils wrapped in muslin which is sterilized at the same time the utensils are sterilized insures the handling of the sterile utensils without danger of contamination.

SECTION V - RUBBER GLOVES

At the close of an operation, all of the rubber gloves which have been used in connection with the operation should be thoroughly washed inside and outside with green soap and water and thoroughly rinsed in a hot solution of Lysol, one percent.

The gloves should be tested for any imperfections. This may be done by inflating or blowing up each glove with air and holding it under water. If there are imperfections in any of the gloves, air bubbles will form and escape from the glove at the place where the hole is located. If there is only a slight hole in a glove, it may be mended, but if the glove is badly damaged, it should be discarded. Discard worn and patched gloves as they cannot be satisfactorily sterilized.

The gloves that are to be sterilized should be boiled in plain water for 3 minutes, carefully dried, and powdered evenly and very thoroughly on both the inside and outside with sterile talcum powder. This will prevent the surfaces of the gloves from adhering to each other during the sterilizing process. To make it much easier for the surgeon to put on the gloves, the wrist of each glove should be turned back to form a cuff of about one and one-half inches deep and a small envelope containing about one teaspoonful of talcum powder should be placed in the cuff of each glove. The gloves are now ready to be placed in the glove covers.

The glove covers may be made of a heavy muslin, very similar in design to a simple bill-fold with a pocket on each side of the line along which the cover folds. The cover should be made of such size that each pocket will be about 10" long and 5½" wide.

Only one glove should be placed in each pocket, after which the covers should be folded together so that the gloves will be on the inside. The folded covers containing the gloves should be wrapped in two layers of muslin so that when the cover packet is completed, each glove will be covered with at least three layers of muslin. The packages of gloves made up in this

way should be packed loosely in the sterilizing chamber of a high pressure dressing sterilizer and sterilized with high pressure steam for a period of 15 minutes at a steam pressure of 15 pounds. (Do not leave gloves under steam pressure for longer than 20 minutes at any one time). At the close of the sterilizing period, a vacuum of from 8 to 10 inches should be drawn and maintained for a period of 10 minutes to thoroughly dry out the gloves and covers. If the gloves are to be stored, it is important that the gloves and packages be thoroughly dried.

If gloves are packed in muslin covers and sterilized as described above, then placed in sterile metal containers protected from dust, they will remain sterile for at least one week.

SECTION VI - TALCUM POWDER

Sterilize talcum powder by placing 2 ounces in an aluminum shaker in the autoclave and sterilize it for a period of 30 minutes with high pressure steam at not less than 250° F.

SECTION VII - VASELINE

The usual method of sterilizing vaseline is to take a two-ounce bottle of vaseline, place it in the autoclave and sterilize it for a period of 30 minutes with high pressure steam under a pressure of 18 pounds.

SECTION VIII - MILK

The milk should be put in sterile bottles, the mouth of each bottle covered with a six inch cotton disc and the disc secured to the mouth of the bottle by means of a rubber band. The six-inch cotton discs may be secured from any dairy supply house. The bottles of milk should be set in pans in the sterilizing chamber of the autoclave at room temperature and the door of the sterilizer closed, steam tight. The pans should be large enough to hold the milk if the milk should boil over or if a bottle should break. The necessary steam pressure should be turned into the steam jacket of the sterilizer but ample time should be allowed for the bottles and milk to become thoroughly warmed before any steam is turned into the sterilizing chamber.

When this has been accomplished, the steam should be turned into the sterilizing chamber and the milk sterilized at 15 pounds steam pressure for a period of 13 to 15 minutes, or at 18 pounds steam pressure for a period of about 10 minutes. Under any conditions, the period of sterilization must not be long enough to caramelize the sugar in the milk and to turn it brown.

At the close of the sterilizing period, the valve marked "Steam in Chamber" should be closed and the sterilizer and the milk allowed to cool down gradually which will require from 20 to 30 minutes. A vacuum should NOT be drawn. If a vacuum is drawn, or if the vacuum breaking valve in the door of the sterilizer is opened, allowing the steam to escape from the sterilizing chamber at the close of the sterilizing period, the milk will boil over into the sterilizing chamber or pans. For this reason, milk must not be sterilized in an autoclave at the same time dressings are being sterilized.

When the sterilizer and the milk have cooled down sufficiently, the sterilizer door may be opened and the milk removed from the sterilizer.

If a DIRECT STEAM HEATED AUTOCLAVE is used to sterilize the milk, it is very important that sufficient time be given for the bottles to become well heated before the sterilizing period is started. The steam must be turned into the sterilizing chamber slowly by gradually opening the "Steam in Chamber" valve which admits the steam to the chamber. Failure to do this will result in broken bottles and wasted milk.

SECTION IX - SALINE SOLUTIONS

Prepared solutions should be put in 1000 cc. sterile flasks stoppered with tightly fitting cotton plugs, the plugs and the necks of the flasks covered with two or three layers of gauze, and the gauze tied to the necks of the flasks with a string. 1000 cc. flasks should be used rather than 2000 cc. flasks since the larger flask requires twice as long to sterilize. Corks or rubber stoppers should not be used as they may blow out when the solutions are heated in the sterilizer. The flasks should be set in pans in the sterilizing chamber and sterilized for a period of from 15 to 20 minutes with high pressure steam under a steam pressure at not less than 250° F. The pans should be large enough to hold the solution should a bottle break or the solution boil over.

At the close of the sterilization period, a vacuum should NOT be drawn. The steam should be shut off from the sterilizing chamber and the sterilizer allowed to cool down gradually. If a vacuum is drawn, the solutions will boil over, and, in time, the action of the salt may seriously damage the interior walls of the sterilizer. Solutions should not be sterilized at the same time that dressings are being sterilized.

SECTION X - GLUCOSE SOLUTIONS

Heat has no injurious effects on saline solutions, but it does seriously affect glucose solutions unless the glucose solutions are properly prepared. The glucose should be dissolved in distilled water and put in 1000 cc. flasks. Cover the flasks with two layers of gauze held in place by a rubber band. This will protect the necks of the flasks from contamination by handling. The flasks should be placed in pans in the sterilizer (the pans should be large enough to hold the solution should the flask break or the solution boil over), and sterilized for a period of from 20 to 30 minutes with high pressure steam under a pressure at not less than 250° F.

At the close of the sterilization period, a vacuum should not be drawn. The steam should be shut off from the sterilizing chamber and the sterilizer allowed to cool down gradually. If a vacuum is drawn, the solution will boil over, and, in time, the action of the solution may seriously damage the interior walls of the sterilizer. Glucose solutions should not be sterilized at the same time that dressings are being sterilized.

If hard water, instead of distilled water, is used to dissolve the glucose, it will result in breaking down of the sugar during the sterilizing period. This is caused by the alkaline salts in the hard water being heated with the glucose. A brown liquid, - caramelized sugar - will be the result. Should a glucose solution plus certain alkaline salts be required, they should be sterilized separately and mixed after sterilization.

If 2000 cc. flasks are used, twice the time will be required to reach the minimum sterilizing temperature as that for 1000 cc. flasks.

SECTION XI - DISTILLED WATER SODIUM CITRATE, and OTHER SOLUTIONS

The same procedure as described under Section X - Glucose Solutions - should be followed for the sterilization of distilled water, sodium citrate, and other solutions.

SECTION XII - BLOOD SERUM

Blood serum can be sterilized satisfactorily only in autoclaves fitted with a shut-off valve in the exhaust line from the chamber so that all openings to the chamber may be tightly shut off when desired. When sterilizing blood serum it is absolutely necessary that no bubbles are formed in the serum during the process. The following procedure is generally accepted to be satisfactory. Place the tubes on an angle in wooden trays in the chamber and close the door. DO NOT DRAW A VACUUM. Close the valve in the exhaust line from the chamber so that the air cannot escape from the chamber and then open the STEAM-IN-CHAMBER valve to fill the chamber with 15 pounds steam pressure. Shutting off the escape of air will cause the pressure in the chamber to rise more rapidly than the temperature thus preventing the formation of bubbles in the serum.

When the chamber gauge indicates 15 pounds, open the valve in the air exhaust line from the chamber VERY SLOWLY, so that the chamber pressure gauge shows no drop in pressure, until the valve is fully open. Then sterilize as required. At the end of the sterilizing period, DO NOT DRAW A VACUUM but close all valves including the valve in the exhaust line and allow the sterilizer to cool down very slowly by radiation. At least 30 minutes should be required to drop the pressure in the chamber from 15 pounds to zero. If the room is too cool or leaking valves cause the pressure to drop too fast, the steam supply valve may be slightly cracked to slow the movement. Do not open the sterilizer for at least five minutes after the chamber gauge has reached zero.

Chapter VI

SUTURE MATERIAL

Suture material may be divided into two large groups: absorbable, and non-absorbable.

The absorbable materials are:

1. Plain catgut.
2. Chromicized or tanned catgut.
3. Kangaroo tendon.

The non-absorbable materials are:

1. Pagenstecher or celluloid line.
2. Silk.
3. Silkworm gut.
4. Horsehair.
5. Silver and other wires.

THE PREPARATION OF THE CATGUT

The material which we call catgut is derived from sheep's intestine. The intestine is thoroughly washed; its muscular and mucous membrane coats with any adhering fat are removed, leaving the submucosa as clean as possible. This is the strongest layer. The submucosa is cut into very narrow strips, which are twisted together in varying numbers to make the different sizes of catgut. These twisted strands are dried and the material is ready for sterilization.

For a number of years, chemical sterilization was used. This was found impractical for two reasons, first, in catgut of any thickness it was unreliable, and second, chemical agents which were strong enough to kill the bacteria also destroyed the tensile strength of the gut. Experiments were then undertaken with heat as the sterilizing agent. This at first produced a catgut which, on account of its rigidity and lack of pliability, was useless for surgical purposes. Further experimentation, however, soon produced a fairly soft and pliable catgut. The various manufacturers sterilize their catgut in different ways. The method which will be described is one that has been successfully used by one of the largest catgut firms. The catgut is exposed to excessive degrees of dry heat on several successive days. Following this, it is boiled in alboline at a temperature of 320°. It is then cut in suitable lengths and placed in tubes containing a solution which is antiseptic and which keeps the catgut fairly pliable. These tubes are then labeled, giving size of catgut, type of gut, whether plain or chromicized, and method to be used for sterilization of tubes; whether to boil or soak them in an antiseptic solution.

1. No. 1 catgut is the size generally used for most purposes unless the operator asks for fine catgut. In that case give # o or # oo. If heavy catgut is called for give # 2 or # 3. The size of the catgut used varies with different operators. The operating room nurse will do well to find out just what size catgut the particular operator desires for general use and have it ready before the operation is begun.

The catgut strands are usually about 60 inches long. These strands have to be cut in various lengths according to their particular use. Some men prefer to use a double strand of fairly fine catgut in preference to a single strand of heavy gut. It is essential for the nurse to find out the exact method the operator desires and to have that ready.

NON-ABSORBABLE MATERIAL

Linen. - Pagenstecher is linen thread that has been impregnated with a material which makes it non-capillary. It is used chiefly in gastro-intestinal surgery. It comes in varying thicknesses according to its number.

Silkworm Gut. - This is obtained from the silkworm. It is the silk before it has been spun. The caterpillars are killed and the unspun silk drawn out in the form of a strand. The thickness of these strands varies very much. Silkworm gut is a stiff, smooth, strong, non-absorbable material, in appearance closely resembling spun glass. It is used mainly for tension sutures. Because of its stiffness and its limited length, it is occasionally difficult to tie.

Silk. - This is used mainly for suturing the skin. It is either black (iron-dyed) or white, and comes in varying thicknesses according to its number. The smaller the number the finer the silk. Recently there has been produced a moisture and serum-proof, iron-dyed non-capillary, surgical silk varying in size from # 1, which corresponds to # ooo catgut, to a # 8 which equals a # 5 catgut in thickness. This silk is of great tensile strength, runs uniform and even in size and comes in fairly large spools so that it can be cut in any length. It can be sterilized by boiling. Reboiling apparently does not destroy its tensile strength. There is one precaution relative to sterilization that must be observed, it should not be kept in alcohol.

Horsehair. - This is used mainly as a skin stitch. It is never buried. In the preparation of horsehair it should be thoroughly washed with soap and water and then boiled in soda solution for ten minutes. This is to prevent any possible contamination of the hair with tetanus spores.

Sterilization of the Non-Absorbable Materials. - Silkworm gut, horsehair and silver wire may be boiled. Pagenstecher linen should be sterilized in its original glass container, or, if it is bought loose, in the steam autoclave. It should not be boiled. If it is boiled it becomes very coarse and difficult to thread. Silk may be boiled or sterilized in the autoclave. If it is boiled, it should not be wound on a glass spool, because the glass, in the process of boiling, expands, while the silk contracts. This opposing action of the two materials causes a rupture of some of the strands in the twisted silk, thereby weakening the silk, though not actually breaking the thread. A far better plan is to wind the silk loosely around a rubber spool or a piece of cardboard before boiling.

After careful study and animal experimentation, it was found that in some organs, the catgut was absorbed before the tissues which the gut approximated, had healed; therefore some method of treating or preparing the catgut had to be devised which would make it less absorbable. The most popular method up to recent times was to formalinize the gut, but this rendered the catgut extremely hard and harsh so that it was almost as difficult to handle as a piece of wire. It was also extremely difficult to abstract the surplus formalin from the strand, making it highly irritating to the tissues. This method has been practically discarded, and, at the present time, one of two methods is used: Either the chromic or tannic acid method. In these methods, the catgut is impregnated with a salt of either chromic or tannic acid. After the catgut has become impregnated with the salt, its absorption time varies according to the thickness of the gut and the amount of chemical it has absorbed. These medicated ligatures resist absorption from 20 to 30 days in muscle and from 10 to 15 days in serous or mucous membranes.

There are three kinds of absorbable suture material used:

1. Plain catgut.

2. Chromicized or tanned catgut.

3. Kangaroo tendon.

They each have their special indications. Plain catgut is used when a material that is absorbed in less than 10 days is satisfactory. Chromicized gut is used when coaptation for 20 to 30 days is necessary. If approximation is required to last longer than 30 days and the operator desires to use an absorbable material, kangaroo tendon is used. This may not be absorbed for 60 days. The strands of kangaroo tendon vary from 10 to 14 inches.

CATGUT TABLE

The following catgut table can be used as a working basis:

	No. of Catgut	Kind	Number of Pieces into which the Strand is cut.
Ligatures	#o	Plain	Cut in four
Peritoneum	#1, single or double	Plain	Cut in two
Muscle	#1, single	Plain	Cut in two
Fascia	#1, single or #o, double	Chromic	Cut in two
Subcutaneous tissue	#o, or #oo, single	Plain	Cut in two
Aneurysm needle	#2	Plain	Cut in three, in pelvic work cut in two
Stomach, intestines	#o	Chromic	Special thread or cut in two

Use of Non-Absorbable Material. - Non-absorbable material is very rarely buried. Occasionally, heavy silk or linen is used in the ligation of large arteries. By far the most frequent use of non-absorbable material is in suturing the skin. For this purpose silkworm gut, silk and horsehair are used. Silkworm gut and heavy silk are frequently used as a figure of eight retention stitch to hold the two edges of the fascia together, as well as the skin.

Silver and other types of wire were used for suturing the deep layer in hernia operations, for suturing the cervix, and as a through and through retention stitch in the abdominal wall in urgent laparotomies. These various uses have gradually been discontinued. Now, practically the only place where wire is used, is in bone work, and even here, it is being gradually replaced by absorbable material (kangaroo tendon, chromic catgut).

Needles. - For descriptive purposes all surgical needles may be divided into three parts:

1. The eye.

2. The shaft.

3. The point.

The Eye. - The eye of the needle may go either from side to side, or from before backward. It may be round, oblong, or oval. It should be large enough to allow a fairly easy passage for the type of suture material used. It should not be so large as to cause any widening of the needle. Some clinics use a needle with a special self-threading eye for routine work. In most clinics this needle with the self-threading eye is used only in the supertechnic.

The Shaft. - The shaft of the needle may be:

1. Straight.

2. Curved.

    a. Quarter-circle.

    b. Half-circle.

    c. Five-eighths of a circle.

    d. Fish-hook shape.

    e. Curved at tip.

On cross-section the shaft is either flat or round.

The Point. - The point of the needle may be:

1. Triangular in shape (spear-point).

2. Sharp cutting edge (Hagedorn needle).

3. Tapering point.

4. Trochar point.

Various names have been applied to the different types of needles:

The type of needle used should be strong enough for the tissue through which it is to pass, but otherwise no larger than is necessary to carry the suture. Straight needles are generally used for surface work, while curved needles are used in regions where the recovery of the point after its passage may be very difficult.

NEEDLE TABLE

Name	Eye	Direction of Eye	Shaft	Point	Use
Hagedorn	Round	Side to side	Flat	Sharp cutting edge	For all types of work, except intestinal. Some surgeons use it only in skin and fascia.
Mayo	Oblong	From before backward	Round and Curved	Tapering	For all work except skin and intestinal.
Intestinal	Oval	From before backward	Round, straight or curved	Tapering	For all intestinal work and for any fine work.
Cervix	Oval	From before backward	Heavy Straight, round or curved	Trochar point	For suturing cervix.
Surgeon's cutting	Oval	From before backward	Round, Curved and Straight	Trochar point	Same as Hagedorn needle.

The type of needle used varies according to the preference of the individual operator. Some men use one type of needle for practically all their work, while others change the type of needle with the tissue to be sewed. It is the duty of the nurse to know the individual peculiarities of each operator.

In the sterilization of needles, it will be found advisable, where the desires of the operator are known, to "put up" the various needles he generally uses for each operation in packages, and sterilize them in the autoclave.

Three needles of each type should be placed in the package, two for use during the operation and one in reserve. It will be found very convenient to thread the straight and curved intestinal needles with Pagenstecher linen, and the straight Hagedorn needle with silk, before sterilization.

In threading a curved needle having its eye running from before backward, always thread it from the concavity to the convexity. In this way the thread has to go around a corner before it can become undone.

Chapter VII

SUTURING

It is important that each surgical technician be familiar with the technique of suturing, as many instances will occur which will necessitate such action on the part of the technician. At times medical officers may not be available and at other times such an officer may designate that cases with small lacerations will be treated in the dressing room by a competent technician.

Suture material must, at all times, be kept sterile and not permitted to touch the skin unnecessarily, for even prepared skin has bacteria on it which may contaminate the suture.

In order to properly suture a wound, the following articles must be prepared for use, and must be sterile:

1. Needle holder.
2. Tissue forceps.
3. Several needles (one may break)
   a. Round needles for work beneath the skin.
   b. Cutting needles for skin suture.
4. Suture material.
   a. Dermol or S.W.G. for skin.
   b. Plain or chromic cat gut for muscle and fascia.
5. Scissors.

There are several classical types of suture used in surgery. Their names are listed below and their appearance is shown on the accompanying illustration:

1. Interrupted.
2. Continuous.
3. Lock stitch.
4. Figure of eight.
5. Mattress.
6. Sub-cutaneous.

In order to properly suture, it is necessary to understand how to tie or knot the suture. All knots are begun as simple turns or simple loops. In tying sutures and ligatures, too many loops should be avoided for they will cause too much bulge or pressure. They also provide too large a surface for the deposit of lime salts if they are unabsorbable sutures. Knots should never be tied with short jerks. On the contrary, care should be taken to hold the thumb close to the knot and a steady but general pull exerted. The second stitch should be brought down flat and snugly upon the first so

that the completed knot will be tied securely.

The Simple Knot: This is made by passing the free end of the suture through an overhand or an underhand loop and drawing the ends taut. The simple knot forms the basis of practically all knots.

Compound Knot: By passing the free end two or more times through the loop before drawing the ends taut, a compound knot is formed. This is used as a friction knot to prevent slipping of the suture or the ligature. The compound knot constitutes the first part of the surgeon's knot.

Granny Knot: The granny khot is not used in operative surgery but is mentioned here only for contrast. The steps in the formation of a granny knot consists of taking the same ends through the two loops in opposite directions. In tying the first hitch the end is passed through the loop away from the operator but in tying the second half of the knot the same end is carried through the second loop towards the operator. The objection to the granny knot is that it will easily loosen and become untied if one or both ends are cut short.

Reef Knot: This knot called also the flat or square knot, is used in surgery for tying sutures and ligatures. It consists of two simple knots. The difference from the granny knot is that the end that is brought through is carried in the same direction through both loops.

Surgeon's Knot: The surgeon's knot is a variation of the Reef or flat knot differing only in that the first hitch consists of a compound knot instead of a simple knot. Its advantages are that when tying down the second hitch onto the first, slipping or sliding of the first hitch does not occur and it is less likely to yield before an expanding force within the sutured tissue.

The Stay Knot: This is used in ligating large blood vessels. Its object is to produce as large an area of obliteration of the lumen of the blood vessel as possible. Two separate ligatures are passed around the vessel parallel to each other and side by side and the first hitch of a Reef knot is tied in each ligature separately. Then the two ends are picked up on each side and these double ends are tied as one into a simple knot, after the manner of a second step of a Reef knot.

The proper procedure of suturing is outlined below:

1. Sterilize all instruments.
2. Scrub hands carefully and wear gloves if possible.
3. Have skin around wound scrubbed, shaved, and an antiseptic applied.
4. Infiltrate area with local anesthetic.
5. Thread needle and place in needle holder.
6. Grasp cut edge of wound with forceps.

7. Pass needle through skin on one side of wound and out through skin on opposite side of wound. If wound is jagged, suture points that fit together first. Rotate needle through skin.

8. Tie suture with knot that will not slip such as surgical knot.

9. Approximate skin edges carefully but not too tightly.

10. Leave about one-half inch of suture past knot when cutting to avoid untying of knot and to increase ease of removal later.

The essentials of good suturing are:

1. Use the smallest size suture possible.

2. Be careful to maintain sterile technique.

3. Do not traumatize the wound.

4. Do not tie sutures too tightly as slough may result.

5. Be sure that skin edges are accurately approximated.

TYPES OF KNOTS

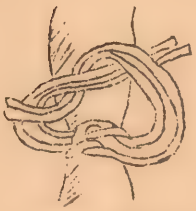
SIMPLE

COMPOUND

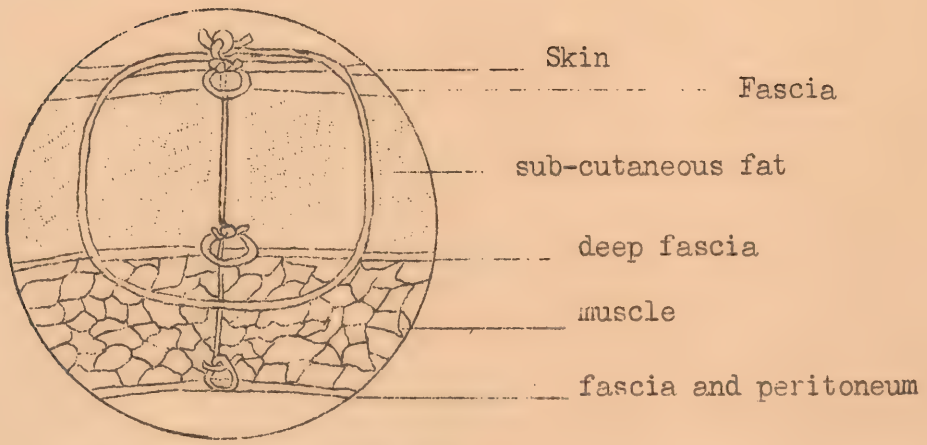
GRANNY

REEF OR SQUARE

SURGICAL

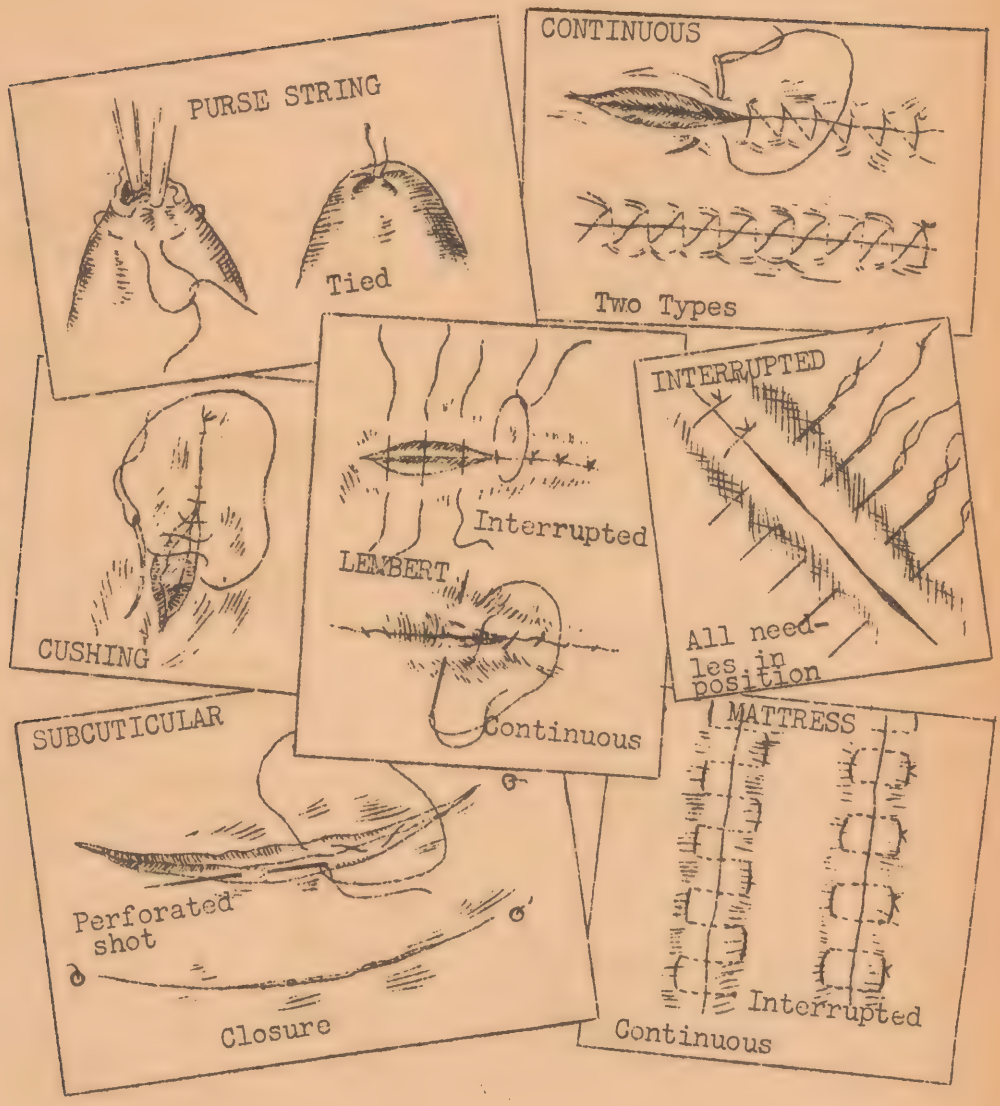


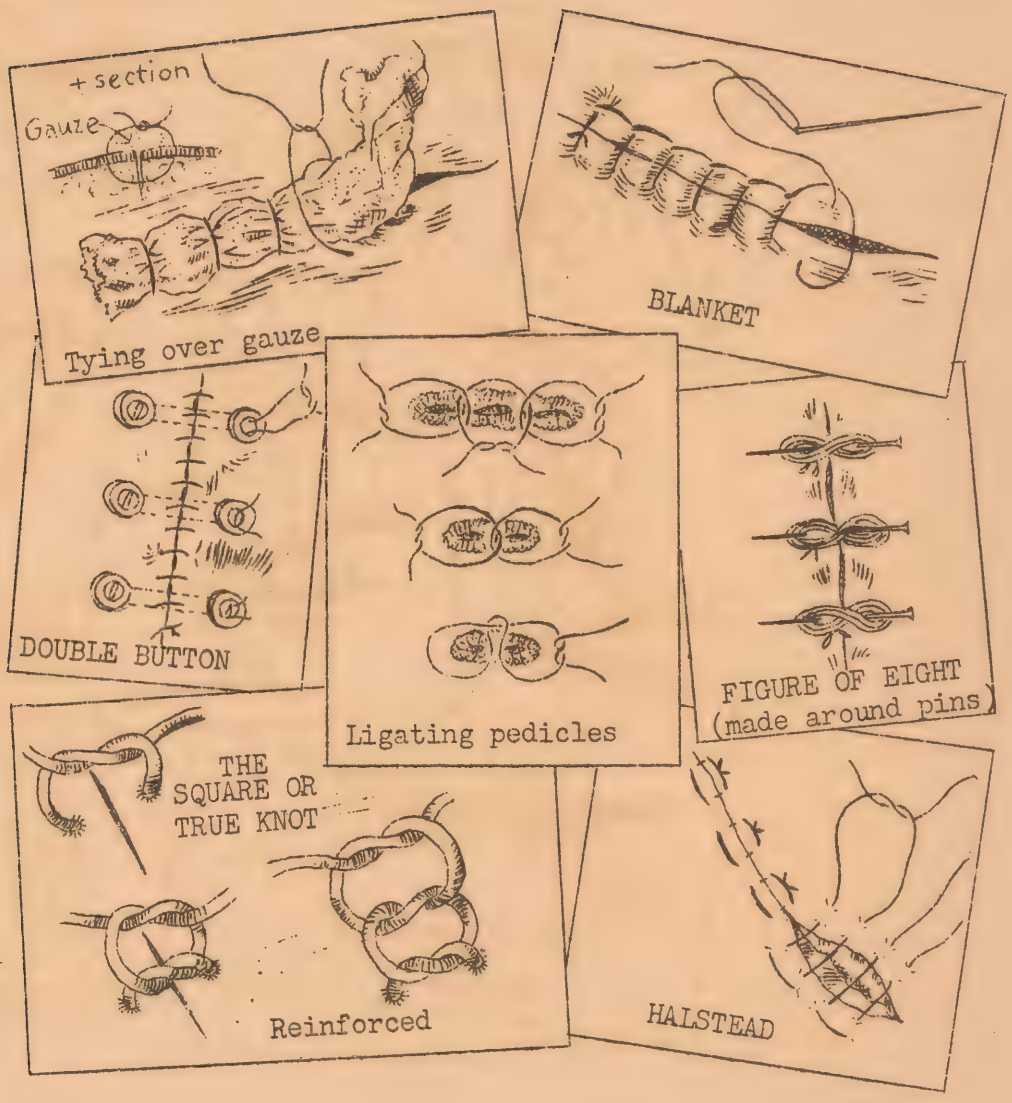
STAY KNOT



SUTURED WOUND ILLUSTRATING
TENSION SUTURE

SUTURE TECHNIQUE (NO. 1)




+ section
Gauze
Tying over gauze
BLANKET
DOUBLE BUTTON
Ligating pedicles
FIGURE OF EIGHT
(made around pins)
THE
SQUARE OR
TRUE KNOT
Reinforced
HALSTEAD

Chapter VIII

PREPARATION OF THE PATIENT

Under this heading we will consider not only the preparation of the patient immediately preceding the operation, but also what the patient should do as soon as operation is decided upon. Except in emergency, it is necessary to see to the condition of the teeth, the gastro-intestinal tract and the kidneys.

Teeth: - If the mouth is in good condition, it aids in preventing post-operative pneumonia and helps towards a smooth convalescence. The teeth should be carefully examined by a dentist, and all carious teeth either filled or drawn. The frequent use of the toothbrush is essential and should be insisted upon in the ante-operative preparation.

Gastro-Intestinal Tract: - The diet for two or three days before the operation should be plentiful and of such character as will leave but little residue, so that when the preoperative care of the gastro-intestinal tract is begun, the stomach and large bowel can be readily emptied. The evening meal the night before the operation should be light. If the operation is to take place in the early afternoon, the patient may have a piece of toast and a cup of broth or very weak tea for breakfast. Fluids should be given freely. There is considerable controversy among medical men as to the type of cathartic to use, the night preceding the operation. Some surgeons use castor oil, others feel that castor oil is far too drastic and dehydrates the patient. The latter use a mild cathartic like Cascara Sagrada, 5 or 10 grains, to bring the feces down to the large bowel, and give an enema to clean out the lower bowel.

In operations on special regions as the stomach, rectum, etc., special rules are followed, which will be discussed under their separate headings.

Kidneys: - As soon as an operation is decided upon, a specimen of the patient's urine should be obtained and examined, to determine the condition of the kidneys and the presence or absence of sugar. The specimen in the male patient may be voided, but in the female, should always be catheterized, in order to prevent its contamination by vaginal secretions. If the examination shows evidence of diseased kidneys or the presence of sugar, proper precautions should be taken so as to improve the condition of the patient. (Rest in bed, forced fluids, proper diet, insulin, etc.)

The mental condition of the patient is a factor which has been frequently overlooked. Every individual who is about to undergo a surgical procedure should be in bed for a period of from 24 to 36 hours before the operation. An operation is an ordeal; it is a distinct strain on the nervous system and the rest will aid the patient. A good night's sleep before the operation is absolutely essential, even if it is necessary to resort to a hypnotic.

Preparation of the Surgical Field: - The preparation of the operative field has changed several times in the last few years. These changes are made from time to time in an endeavor to simplify the procedure without interfering with the asepsis. It is readily understood that the simplest efficient preparation of the operative field is best, because the injury to

the skin is less and its resistance is therefore not lowered.

Every patient, except in an emergency, should have a general bath on admission. The operative field should be cleaned of all hair, visible or invisible. There are two methods of doing this:

1. By using a depilatory.

2. By shaving.

In shaving the nurse should be very careful not to scratch or cut the skin. She should prepare a large area (too large rather than too small.) After the hair is removed, the skin is washed with soap and water and then thoroughly dried. Ether is applied to the entire area and allowed to evaporate following which the area is washed with 65% alcohol. A sterile dressing is applied and the skin allowed to dry thoroughly. When dry, the sterile dressing is removed, the part is painted with some form of "skin sterilizer," and another sterile dressing applied. This dressing is not disturbed until the patient is brought to the operating room when it is removed and the part is again painted with "skin sterilizer." In an emergency when the patient is brought to the operating room without proper preparation, the operative field should be shaved dry, washed with benzine or gasoline, followed by alcohol and ether, so as to thoroughly remove the fat and then painted with "skin sterilizer."

Chemical Skin Sterilization: - The preliminary preparation of the operative field has not changed materially in the last decade. However, there has been a constant search for the ideal chemical "skin sterilizer." The requirements necessary for the ideal chemical skin disinfectant should be:

1. It must have the ability to rapidly kill the usual contaminating skin organisms. This property should last for several hours.

2. It must be able to dissolve the skin debris and penetrate the surface of the skin.

3. It must dry fairly rapidly so as not to delay the operative procedure.

4. It must have a high color index so that there shall be no question as to the extent of the sterilized area.

5. It must be nontoxic so as not to interfere with the normal healing process.

6. Its application should be painless, particularly for local anaesthesia operation.

7. It must be nonirritating.

8. It must be stable.

9. It must be inexpensive.

The "skin sterilizers" most frequently used are:

Tincture of iodine 3½ and 7%.

Picric acid 5% and 2½% in 95% alcohol.

Mercurochrome 2% in acetone and alcohol (mercurochrome 2 grams dissolved in 35 cc. of distilled water, containing 0.1 gram sodium carbonate, then adding while stirring 55 cc. of 95% alcohol U.S.P. and 10 cc. of acetone U.S.P.)

Precautions:

Tincture of Iodine.

a. Forms a blotchy surface with marginal concentration and skin burns are frequent if iodine is not removed with alcohol.

b. If iodine is allowed to drip around patient's body and patient lies on iodine soaked towels a burn on the back frequently occurs.

c. A large number of people are sensitive to 7% iodine - when iodine is allowed to stand the alcohol evaporates and the solution becomes stronger. This also causes frequent burns.

d. No towels, sheets or linens are to come in contact with the iodinized area while wet. If they do the iodinized sheet causes a burn where it remains in contact with the skin.

e. Cover all iodinized skin with towels so that the intestines do not come in contact with it as the iodine is supposed to cause intra-abdominal adhesions.

Picric Acid:

a. One occasionally finds people very susceptible to picric acid with a resulting generalized dermatitis.

b. All cloths saturated with picric acid and allowed to dry are highly inflammable.

c. Picric acid does not act well in the presence of free albumin (blood, raw tissue) therefore should not be used in open wounds.

d. The solution stains bed clothes and linens for days after its application.

Mercurochrome:

a. Very expensive when compared with other solutions.

b. Red color rather difficult to remove but does not come off on clothes once it has dried.

c. The solution is not difficult to prepare but must be properly prepared in order to get best results. Discoloration from mercurochrome is removed:

1. From the skin, if stain is fresh by the use of acidulated alcohol (2% hydrochloric acid in alcohol).

2. From colorless cotton or linen cloth:

Mix one volume of Labarraque's Solution (chlorinated soda) with four volumes of water. Immerse the stained fabric in this mixture and allow to soak for about two minutes. Without removing the fabric, add one volume of 5% acetic acid (approximately the strength of vinegar) and mix thoroughly with a stick. The stain disappears rapidly and should be completely removed in one minute.

Wet Preparation of the Skin: - In the wet preparation it is essential to prepare as large an area as possible. The clothing is turned back and a rubber sheet placed under the patient to catch the excess of water. The operative field is shaved wet and thoroughly washed with soap and water, an abundant lather being as important as abundant water. Special care is taken to cleanse all the folds, crevices and the umbilicus. In operations on the hands or feet the spaces between the fingers and toes should be thoroughly washed by drawing a strip of gauze between them. The nails are thoroughly cleaned and trimmed down. After the part has been scrubbed with soap and water it is scrubbed with ether for one minute, alcohol for one minute and bichloride 1-5,000 for two minutes. The ether, alcohol and bichloride are applied by wetting a towel held in the hand barber-fashion, the preparation is completed by dipping a towel in 1-5,000 bichloride and placing it over the operative field. This is held in place by a bandage. (In some institutions a soap poultice is used instead of bichloride.) When the patient goes to the operating room, the bichloride towel is removed and the field is again scrubbed with soap and water, ether, alcohol and bichloride by the interne or nurse. Whoever does this in the operating room must be "scrubbed up" before scrubbing up the patient. The great disadvantage of this method is that the patient lies in a pool of water, until the operation is finished.

Chapter IX

PREPARATION OF THE HANDS FOR AN OPERATION

Before beginning the actual process of scrubbing the hands and arms for an operation, one should carefully manicure the finger nails. They should be kept trimmed round and short. Long pointed nails are very apt to tear the rubber gloves.

The method of "scrubbing up" is practically the same in all of the large clinics. It consists of two processes. First, a thorough scrubbing with soap, brush and running water (some clinics do not use brushes because they traumatize the skin; instead, they use a piece of gauze), and second, the use of some type of chemical disinfectant.

A most satisfactory soap is the old-fashioned tincture of green soap or a soft soap. Some operators prefer a cake of soap--in that case--castile or ivory soap is usually used.

The nurse will govern herself by the regulations of the institution in which she is working. She should follow the methods of the surgeon whom she is assisting, for he is responsible to the patient. If there are no specified methods, the following will be found satisfactory:

1. Adjust a cap to cover all the hair, a mouthpiece (to cover the nose and mouth), roll the sleeves well beyond the elbow.

2. Wet the hands and arms thoroughly with water, add a sufficient amount of soap and work this into a good lather covering the surface of the hands, forearms and elbows (always scrub 2 inches above the elbows). After a good lather has been obtained rinse it off and start afresh. Be careful in rinsing arms--elbows and hands, to always hold the hands higher than the elbows to prevent contamination. Always scrub in running water, not in a basin of water.

3. With an orange stick and a little chloride of lime, clean under each finger nail thoroughly.

4. Resoap, relather, scrub and rinse for 7 minutes. The scrubbing with the brush or gauze should be done systematically, beginning with the thumb and in succession scrubbing the inner and outer surfaces of the thumb and fingers, then the palm and dorsum of the hand and then the forearm. If this is done in the same manner every time it soon becomes a habit and one does it unconsciously. Use plenty of water and plenty of soap.

5. Thoroughly wash off all the soap with warm water. One is now ready for the second process, the chemical disinfection. The following are the three most frequently used methods.

THE CHLORIDE OF LIME AND SODA METHOD.--This method is the one in use at the French Hospital. It was first used by Professor Weir, at Roosevelt Hospital, and by Professor Stimson, at the New York Hospital. After the hands have been thoroughly scrubbed with soap and water, take

a moderate quantity of chloride of lime in one hand and some carbonate of soda in the other, add a little water and mix them in the palm of the hand until a creamy mixture is obtained. This creamy mixture should then be thoroughly rubbed in all over the hands and arms. The rubbing in of the chloride of lime and soda should take about two minutes. It is washed off with sterile water, or a 1-10,000 solution of bichloride of mercury. The hands and arms should then be immersed in an arm basin containing 1-10,000 bichloride of mercury for about one minute.

A good point in "scrubbing up" is to place the fingers on the bottom of the basin containing the disinfecting fluid, and push the hands forward so as to allow the disinfecting fluid to enter underneath the finger nails; pushing backward and forward on the pulp of the finger, opens the space between the finger and the finger nail and allows it to become sterilized.

Some men object to this method because of the odor it gives the hands. This odor will be completely lost if, after the operation, the hands are washed in a 1/2% to 1% solution of ammonia water.

POTASSIUM PERMANGANATE METHOD: - This method was originated at the Johns Hopkins Hospital. For this method three sets of arm basins are required.

1. Saturated solution potasium permanganate (warm.)

2. Saturated solution of oxalic acid (warm.)

3. Bichloride solution 1-5,000 or lysol 1-100.

After scrubbing with soap and water for seven minutes, thoroughly wash off the soap and immerse the hands and arms in the potassium permanganate solution for two minutes rubbing the potassium permanganate well into the arms. By this time the hands will be a distinct dark brown. They are removed from the jars and the excess of the solution allowed to drip back. The arms and hands are then placed in a warm solution of oxalic acid. They remain in the oxalic acid jars until all the stain is removed, after which the hands and arms are thoroughly rinsed in sterile water and placed in jars containing bichloride 1-5,000 or lysol 1-100 for about two minutes.

Some operators find these methods very irritating to the skin.

THE IODINE METHOD:—Scrub the hands and arms thoroughly with soap and water for seven minutes. Carefully remove all the soap with warm water. Immerse the hands and arms in a half-strength solution of tincture of iodine (3½%), carefully, introducing it under the finger nails and around the matrices of the finger with an orange stick. Thoroughly rub the solution into the hands for about two or three minutes. Immerse the hands in a solution of 75% alcohol and with a gauze sponge remove as much of the iodine as possible.

The nurse when scrubbing between cases, if she is sure there have been no holes in her gloves and if she is coming from a clean case needs

only scrub for five minutes between cases. If the preceding case was a dirty one she must scrub the full time.

In most institutions the gowns are put on before drying the hands on a sterile towel. This is done to prevent a possible point of contamination in drying the hands in case the towel touch the unsterile coat. After the gowns are adjusted and the hands are dried, rubber gloves are put on.

SCRUB-UP "POINTERS"

Don't use too stiff a brush; don't use one too soft.
When scrubbing up keep your mind on what you are doing,
and you will scrub your hands better.
You need running water, hot and cold.
Use plenty of soap.
Scrub the hands systematically.
Scrub between the fingers. Scrub the webs.
The "scrubbing up" process should take ten minutes.
Use a ten-minute hour-glass to judge your time.

SCRUB CHART

1. Put on cap and mask.

2. Clean nails.

3. Wash hands quickly with soap and water.

4. Pick up sterile brush with sterile forceps. Dip untouched end in GREEN SOAP. Scrub hands, forearms, and elbows 2 inches above elbow for 3 minutes, paying attention to scrubbing around nails and between fingers.

5. Rinse off in running water.

6. Use orange stick to clean nails.

7. Take a fresh sterile brush using hands to pick up, repeat No. 4.

8. Rinse in running water.

9. Immerse hands and wrists in 70% alcohol, using two basins of alcohol.

10. Dry hands on sterile towel from drum.

11. Put on gown.

Chapter X

NOMENCLATURE OF OPERATIONS

ABDOMINAL PROSTATECTOMY—Removal of the prostate gland through the bladder, by an incision through the anterior abdominal wall.

ADENOIDECTOMY—Removal of the adenoids.

ALEXANDER-ADAMS OPERATION—Shortening of the round ligaments of the uterus in the inguinal canal.

ANTERIOR GASTRO-ENTEROSTOMY—The establishment of an artificial opening between the anterior wall of the stomach and the small intestines.

ANTERIOR COLPORRHAPHY—Surgical repair of a laceration of the anterior wall of the vagina.

APPENDECTOMY—Removal of the appendix.

BASSINI OPERATION—Operation for inguinal hernia.

BATTLE INCISION—A vertical incision in the right rectus sheath, with retraction of the rectus muscle—used in appendectomy.

BILLROTH'S OPERATION NO. 1—Consists in performing a posterior gastro-enterostomy on the stump of the stomach following a partial resection of the stomach.

BILLROTH'S OPERATION NO. 2—Consists in performing an anastomosis between the cut end of the stomach and the cut end of the pyloris (end to end anastomosis).

BLAKE'S OPERATION—An operation for umbilical hernia where the fascia is overlapped from side to side.

BLUNT DISSECTION—The separating or dividing of tissues by using a sponge or the not-cutting edge of an instrument.

CERVIX (Amputation of)—Surgical removal of the cervix.

CHOLECYSTECTOMY—Surgical removal of the gall-bladder.

CHOLECYSTOSTOMY—The surgical establishment of a fistula into the gall-bladder.

CHOLEDOCHOSTOMY—The surgical establishment of a fistula into the common duct.

COLOSTOMY—Establishment of an artificial anus by an opening of the colon.

CURETTAGE—The scraping of the interior of the uterus with the curette, for the removal of abnormal tissue or the remains of a pregnancy.

CYSTOCELE (operation for)—Surgical repair of a laceration of the anterior wall of the vagina.

DISSECTION—The separating of tissues by cutting or tearing. (See blunt and sharp dissection.)

EMPYEMA (operation for)—An incision between the ribs or the removal of the part of a rib to establish drainage of the chest.

FEMORAL HERNIA—A protrusion of the abdominal contents through the femoral canal.

FISTULA—An abnormal passage leading from an abscess cavity, or a hollow organ, to the surface, or another hollow organ.

GASTRECTOMY (partial)—Excision of a part of the stomach.

GASTRECTOMY (complete or total)—Excision or removal of all the stomach.

GASTRO-ENTEROSTOMY—The establishment of an artificial opening between the stomach and the intestines.

GASTROSTOMY—The establishment of an artificial opening into the stomach.

GILLIAM OPERATION—A suspension of the uterus by drawing the round ligaments through the anterior abdominal wall.

HAEMORRHOIDECTOMY—Removal of varicosed haemorrhoidal veins.

HERNIOPLASTY—The radical operation for hernia.

HYPODERMOCLYSIS—The subcutaneous injection of fluid usually saline or 5% glucose.

H YSTERECTOMY (abdominal)—Removal of the uterus.

HYSTERECTOMY (supra cervical)—Removal of the uterus above the cervix.

HYSTERECTOMY (supra vaginal)—Removal of the uterus above the vagina.

HYSTERECTOMY (vaginal)—Removal of the uterus by the vaginal route.

INCISIONAL HERNIA—Escape of the abdominal contents through the site of the incision of a previous abdominal operation.

INGUINAL HERNIA—A protrusion of the abdominal contents at the inguinal canal.

INTERPOSITION (Wertheims-Watkins) OPERATION—An operation for cystocele and prolapse of the uterus where the uterus is brought out of the peritoneal cavity and sutured to the pubo-vesical fascia.

INTESTINE (resection of)—Excision of a portion of the intestine.

KAMMERER INCISION—A vertical incision in the right rectus sheath with retraction of the rectus muscle—used in appendectomy.

KIDNEY (decortication of)—Removal of the capsule of the kidney.

LAPAROTOMY—The opening of the abdominal cavity.

LITHOLAPAXY—The operation of crushing a stone in the urinary bladder and washing it out through a large catheter.

LITHOTOMY—Removal of a calculus or stone by a cutting operation, usually applied to a stone in the urinary bladder.

McBURNEY INCISION—An oblique, muscle splitting incision, on the right side, one to two inches from the anterior superior spine of the ileum.

MAYO OPERATION—An operation for umbilical hernia where the fascia is overlapped from above downward.

NEPHRECTOMY—The surgical removal of the kidney.

NEPHROLITHOTOMY—Incision into the kidney for the removal of a renal calculus.

NEPHROPEXY—The operative fixation of a floating kidney.

OLSHAUSEN SUSPENSION OPERATION—A suspension of the uterus by suturing the round ligaments to the anterior abdominal wall.

OOPHORECTOMY—Removal of the ovary.

OVARY(resection of)—Removal of a section of the ovary.

PAN-HYSTERECTOMY—Removal of the entire uterus including the cervix, tubes and ovaries.

PARA-MEDIAN INCISION—An incision made in the anterior abdominal wall just to the right or the left of the mid-line.

PERINEAL PROSTATECTOMY—Removal of the prostate gland through the perineum.

PERINEORRHAPHY—Surgical repair of a lacerated perineum.

PFANNENSTIEL INCISION—A transverse incision about an inch above the symphysis pubis; used in gynecological operations.

POLYA'S ANTERIOR OPERATION—Consists of the performance of a gastro-enterostomy following a resection of the stomach. The intestine (usually jejunum) is brought in front of the transverse colon.

POLYA'S POSTERIOR OPERATION—Consists in the performance of a gastro-enterostomy following a resection of the stomach. The intestine (jejunum) is brought through an opening in the transverse mesocolon.

POST-OPERATIVE HERNIA—The protrusion of the abdominal contents through the site of a previous operation.

POSTERIOR COLPOTOMY—Draining of the posterior cul-de-sac through the wall of the vagina.

POSTERIOR-GASTROENTEROSTOMY—The establishment of an artificial opening between the posterior wall of the stomach and the small intestine.

PROSTATECTOMY—Removal of the prostate.

PYELOLITHOTOMY—Incision into the pelvis of the kidney.

PYLORECTOMY—Excision of the pyloris. (Prepare as for a resection of the stomach.)

RECTOCELE (operation for) The surgical repair of a lacerated perineum and posterior vaginal wall.

RETROFLEXION of the uterus, a bending backward of the body of the uterus on the cervix.

(OPERATION for)—Some form of uterine suspension.

RETROVERSION of the uterus—a backward displacement of the uterus without the formation of an angle between the body and the cervix.

(OPERATION for)—some form of uterine suspension.

SALPINGECTOMY—Removal of the Fallopian tube.

SALPINGO-OOPHORECTOMY—Removal of the Fallopian tube and the ovary.

SHARP DISSECTION—Separating or dividing tissues by cutting.

SIGMOIDOSTOMY—An establishment of an artificial anus by an opening into the sigmoid.

SKIN GRAFTING — The placing of small pieces of epidermis or larger strips of the entire skin on a denuded surface, in order to supply the defect of, or to stimulate a new growth of epidermis.

SUPRA-PUBIC CYSTOTOMY—The making of an opening into the bladder by an incision just above the symphysis pubis.

T. & A.—Tonsillectomy and adenoidectomy.

THORACOTOMY—An incision between the ribs or the removal of a part of a rib, to establish drainage of the chest.

THYROIDECTOMY (partial)—Removal of a part of the thyroid gland.

TONSILLECTOMY—Removal of the entire tonsil.

TRACHELORRHAPHY—Repair by suture, of a laceration of the cervix uteri.

TRANSFUSION—The transfer of blood from one person to another.

UMBILICAL HERNIA—A protrusion of the abdominal contents through the umbilical ring.

UTERUS (fixation of)—Suture of the uterine body to the anterior abdominal wall.

UTERUS—Retroflexion of, see Retroflexion. Retroversion of, see Retroversion.

VENTRAL HERNIA—Protrusion of the abdominal contents through the scar of a previous operation.

WATKINS OPERATION—Interposition operation for cystocele with uterine prolapse.

WEBSTER-BALDY OPERATION—Shortening the round ligaments by plicating them behind the uterus.

WERTHEIMS OPERATION—Interposition operation for cystocele with uterine prolapse.

WILLYS-ANDREW OPERATION—An operation for inguinal hernia in which the spermatic cord is transplanted on top of the external oblique fascia—subcutaneously.

Chapter XI

OPERATIVE POSITIONS AND DRAPING

It is something of an art to arrange the patient in a good and stable position and to place the sterile draping so that it will be unobtrusive and at the same time serviceable and durable. Anyone can lay towels and sheets around an operative field but it takes study and ingenuity to do it well. Likewise, there are many points about the various positions which, to be appreciated, must be studied and practiced carefully.

A very important lesson to be learned before undertaking to arrange operative positions is that of the mechanical structure of the operating table and the manipulation of its adjustable parts. Many tables are rather complex in their mechanism but every attachment and adjustment serves some helpful purpose if understood and used properly, and the operating room nurse will avoid much confusion and inconvenience in her department if she sees to it that she is master of all the intricacies of this very important article of her equipment.

In all cases of local anesthesia special effort must be made to make the patient as comfortable as possible. A softer pad (a mattress, perhaps) should be used on the table; small pillows should be used freely wherever they will give support or comfort; sufficient covering to suit the patient's feelings should be applied; if rubber sheets or sandbags are necessary a towel should separate them from the patient's skin; and so on.

We shall now take up the representative operative positions and the sterile draping suitable for them. If not definitely mentioned it will be understood, of course, that the operative field has been sterilized immediately after the position has been arranged and before the sterile draping is adjusted. Also, as it will be monotonous to mention it each time, we shall here lay down the rule that a rubber sheet will be thrown over the patient, table, sandbag, etc., in any place where there is likely to be much drainage from the operative field.

Dorsal Position. This is the most frequently employed position and it is used for most operations on the intestines, stomach, pancreas, spleen and bladder. In some cases the patient is simply placed flat upon the back but in others there will be a small pillow under the "small" of the back and a larger one or a small sandbag under the thighs. The pillow under the back will be especially desirable for women, whose backs curve more than men's and it will serve the purpose of preventing the severe backache which so frequently complicates convalescence from a long abdominal operation because it keeps the muscles of the back in their natural position and prevents the strain upon them which would otherwise occur. The pillow under the knees provides relaxation of the abdominal muscles which results in much less strain upon them and thus enables the surgeon to retract them out of his way more easily, and with less injury to them when doing an abdominal operation.

The arms may be arranged in various ways but these two will answer all purposes for this position: (a) They may be fastened at the patient's side

by means of a folded towel which is passed across the table under the patient's back and an end either pinned about each forearm or turned over each arm and then tucked under the patient's body. (b) They may be laid against the chest with the hands well outward on the shoulders, the sleeve pinned to the shoulders of the gown, and the tail of the gown tucked about them to hold them in place. The arms are less obtrusive, as a rule, when lying at the patient's side but there are many operations in which this practice is technically unrefined, for instance, in abdominal cases in which pus, irrigating solutions, etc., may run down over the arms and hands thus placed.

The position established, the operative field is now sterilized and for this there should a simple draping with sterile towels so placed as to protect the sponge and the gloves from unsterile sheets and table fixtures. The field sterilized, these towels should be left undisturbed because they cannot be removed without danger of contaminating the field.

The sterile draping for this position is relatively simple and is done in one of two ways: (a) The laparotomy sheet is laid over the patient very carefully, two persons being almost necessary for this in order not to run the risk of dragging the sheet over the patient and thus unsterilizing it underneath in parts which may later be drawn up into the operative field. There are several ways in which this sheet is sometimes folded before sterilization so that one person can apply it but they require a great deal of time, and since there is always more than one person sterile for any operation for which this sheet will be appropriate an assistant can always be found. Or, if carefully done there can be no objection to an unsterile person handling the end which is placed at the patient's head because this is unsterilized immediately in any case. (b) Two sheets and four towels may be arranged and it should be noticed that the towels which run lengthwise of the patient are put on first and the crosswise ones laid over them because this is the much more secure way and it brings the towel edges into positions where they will be less likely to cause annoyance by catching on instruments or by being brushed out of place by the arms of the surgeon and assistants. The two crosswise towels will keep the draping in place much better if they are wet, but if the operative field has been painted with iodine there may be objections to the use of wet towels here. A towel clamp will be needed at each of the four corners of the field to keep the draping in place.

Trendelenburg Position. For this position the patient is first placed in the dorsal position, the foot section of the table is dropped, and the whole table top is then inclined, with the foot upward, at an angle of 45° or less, care having been taken to have the patient's knees exactly opposite the hinge of the footpiece. It will be necessary to have the patient braced in some way at the shoulders so as to prevent his slipping downward. Almost any table will have shoulder guards for this purpose but in their absence sandbags will serve well or the shoulders may be lashed to the table with a strong bandage.

The pillows under the back and knees will serve the same purpose here as in the dorsal position. The hands and arms are arranged as for the dorsal position.

This position is used for gynecological and other pelvic operations as it causes the intestines to gravitate out of the way and also brings the pelvic contents up from the bony cavity in which they would otherwise be more or less inaccessible.

The draping for the Trendelenburg position is the same as for the dorsal position.

Gall Bladder Position. In some cases the dorsal position will answer for operations on the gall bladder, but oftener the region will have to be thrown upward so as to bring the organ out from under the ribs. If your table is not adjustable a pillow or small sandbag will answer the purpose.

The draping for gall bladder operations will be the same as for the dorsal position.

Kidney Position. The patient is turned on his side with the lower arm at his back, the other up toward the face, the uppermost knee and hip joints flexed so as to bring the knee down upon the table in the capacity of a brace to keep the body from falling forward, the chest is braced anteriorly with a large sandbag, and sometimes the pelvis also will need the support anteriorly of a heavy sandbag. The crosswise rest is now screwed upward directly under the location of the kidney, or the table is broken there, so as to throw the organ as well outward and upward as necessary from under the ribs. Foresight should be used to see that the patient is properly placed in relation to these breaks in the table before any of the preceding adjustments are made so that the adjustment of the table will not disarrange the position of the patient. When properly arranged the patient will incline very slightly forward from the true lateral position. This is the most difficult position to arrange and a great deal of practice should be devoted to it by the beginner.

The draping for kidney operations corresponds to that for the dorsal position.

Prone Position. The patient lies flat upon the table with the face downward and the arms above the head. Special care of the head must be taken in arranging this position. Some tables are so constructed that a section at the head may be lowered somewhat to allow the patient's head the required room, but in place of this a small pillow or sandbag may be placed under one shoulder.

The position is used for some operations on the spine or other parts of the back.

The dorsal position draping may be adapted to this position.

Lateroprone Position. This is used for some operations on the chest and the hip. The body is turned about halfway between the lateral and the prone positions and the chest and hips rest against sandbags, the lower arm lying at the back and the other upward toward the face.

The dorsal draping is adaptable to this position.

Reversed Trendelenburg, or Kraske Position. The patient is placed upon the table face downward with the hip joints directly over the line at which the foot section of the table breaks, with the arms over the head. Screw the table upward as in the Trendelenburg position, allowing the foot to drop at the same time. The patient will be so well balanced in this position, in most instances, that the shoulder guards will not be needed.

This position will be used for some operations on the rectum.

The principles of the dorsal draping will apply here.

Sims Position. This is used for examination of the rectum in some cases and for some rectal operations. There is no essential difference as to the arrangement of the patient's body between this position and the latero-prone one except that the patient will always lie on the left side.

The principles of the dorsal position draping may be adapted to this position or, for an examination in which the draping may not need to be sterile it may be done with one sheet.

Lithotomy Position. For this position some kind of leg supports, called stirrups, are needed and metal ones are supplied with all operating tables. The stirrups are put into place, the foot of the table is dropped, the patient's feet being held meantime, the patient is drawn down so that the buttocks project slightly over the end of the table, and the legs are then fastened upward and backward so as to throw the knees well backward toward the abdomen. Sometimes a sandbag may be placed under the buttocks to adjust the position of the pelvic organs or, for the same purpose the foot of the table may be slightly elevated. A kelly pad or a rubber sheet should be used over the end of the table. In this position the arms will have to be arranged at the chest.

The lithotomy position will be used for some gynecological, urological and rectal operations.

The draping may be done with a sheet and towels, or better, with the lithotomy stockings and lithotomy sheet.

Breast Position. For operations on the breast the patient will lie upon her back. If the disease is malignant the axillary glands will be removed as well as the breast and in this case the arm on the affected side must be free. Usually a small pillow or sandbag will be needed under the shoulder on this side to throw the axilla well up from the table. The uninvolved arm is best placed at the side.

For a simple breast operation the dorsal draping will apply. When the axilla is involved, however, the draping is more complex and may be done as follows: After the operative field has been sterilized the patient's head and shoulders are lifted, a rubber sheet is spread under the shoulders and over the side of the table by an assistant, and a sterile sheet is then passed under the shoulders so that the table is well covered in the region of the axilla. The hands and forearm, which have been held by an unsterile assistant, are then covered with sterile towels, beginning at the hand with

one which is folded once crosswise making a nearly square cover which is allowed to fall in folds about the wrist, and continuing from the wrist to the operative field with towels folded lengthwise, bandage fashion. Wet towels are better for this purpose as they stay in place better, though when iodine is used on the operative field dry towels must be used as this is approached. Instead of using towels for the hand and forearm a muslin mitten may be used, this being bound down at the border of the operative field by either a narrowly folded towel or a gauze bandage. The general principles of the dorsal draping may then be applied, the arm and axilla being part of the operative field, of course.

There is a table attachment—The Kocher guard—which is very useful in the breast case. It is simply a semicircular piece of soft metal which is fitted vertically across the table in about the plane of the patient's chin and serves the purpose of holding the upper sterile sheet well up between the operative field and the anesthetist. This is a very serviceable attachment generally and if not supplied with the table, it may be very easily improvised. There are other devices designed to serve the same purpose but the Kocher guard is adaptable to a greater variety of positions as it can be bent into any desired shape. A guard of this kind is very desirable as a routine for the isolation of the anesthetist, head cases being the only ones to which it will not apply.

Arm Position. Many hand and arm operations can be done with the part simply laid upon the patient's body, but often a small table will be needed, an arm board which is supplied with some tables may be attached, or a simple long, narrow board may be used.

The laparotomy sheet will serve well in some cases for draping, the arm being simply slipped through the opening and unsterile parts of the arm wrapped; or two sheets may be arranged as for the leg, any uninvolved part of the arm or hand being wrapped the same as for the breast case.

Leg Positions. A great variety of positions are needed from time to time for operations on the various parts of the legs depending upon whether the anterior or the posterior aspect or both must be accessible. The simple dorsal position with a sandbag under the heel will answer for the anterior aspect of the leg and for the foot except when the heel is involved, in which case it may be necessary to turn the patient either upon his side or his face, and in this latter position, of course, the posterior aspects of the legs are also accessible.

Another plan which gives access to all parts of the feet and legs is to suspend them from the table stirrups which are used for the lithotomy position.

The draping for leg cases is difficult but two large sheets and a few towels will answer all needs. The parts are first sterilized, of course, and the necessary sandbags and rubber sheets put into place and then, while a sterile assistant holds the legs upward a sterile sheet is passed underneath them over the entire foot of the table and well upward to the border of the operative field, another sheet is thrown over the patient's trunk and downward to meet the other one, and the edges of the two are then clamped together between the legs and on the outside. Extra towels may be placed on the sheet

underneath the parts, of course, if thought necessary for safety.

When the feet are not included in the operative field they must be well wrapped in towels after the fashion advised for the hand, or, a very convenient plan is to use a heavy white cotton sock or stocking which can be securely clamped at the edge the same as the towel. Any uninvolved part of the leg should also be covered. When only one leg is involved the only variation will be that the other will simply be covered with the lower sheet.

As in the case of the arm, the laparotomy sheet will be found convenient for some leg cases, especially when the operative field is on the thigh or about the hip joint, the leg being simply slipped through the opening, of course.

When the stirrups are used they may be sterilized by boiling if a sterilizer large enough is available and otherwise they may be wrapped with sterile towel.

Head Positions. For operations on the face, mouth and any part of the skull except the back of it a small sandbag or firm pillow of some kind will usually be needed under the head to stabilize it. This will simply be adjusted so as to make the operative field most accessible.

For the face and mouth (tonsils, tongue, etc.) and the front and top of the skull the patient's body will be in the dorsal position and the head turned as necessary.

The draping for operations on the face or mouth is done as follows: The patient's head and shoulders are held up and a sheet with a towel laid on it is passed underneath so that the sheet will extend well up under the shoulders and the towel will come into position directly under the head which is now laid upon the towel. This towel is then wrapped and clamped securely around the head and hair, a sheet is thrown over the patient's body and clamped about the neck to the lower sheet.

For the forehead or temporal region it will usually be possible to apply this same draping principle with the towel merely shifted to expose the operative field.

The draping for the top of the skull may be done thus: The usual sandbag and rubber sheet are adjusted, the patient's head is held from the table and sterilized, a sterile sheet is passed well under it, and the head may then be laid upon this after which the top sheet is applied and clamped to the lower one about the neck.

For mastoid operations or others about the ear, cheek and side of the neck the face guard is convenient for isolating the anesthetist. The metal plate lying on the head, with its supports, is detachable and may be sterilized by boiling, or, of course, it may be well covered with towels by applying the principle of the dorsal draping to the operative field, the edge of the towel lying over the guard (lengthwise of the patient) being turned under the edge of the guard. In most such cases it will be possible and advisable to cover in advance the unsterilized part of the head. In place of a special face guard a towel applied about the face will answer the purpose

of isolating the anesthetist in such cases.

For the back of the head and perhaps in spinal cases it may be necessary that the patient's head be not turned sidewise, so for administration of the anesthetic the head must clear the table. The principle of the dorsal draping will answer the purpose in any such case, even the laparotomy sheet being adaptable, though mercy for the anesthetist, who must always work "below deck" in such cases, would favor towels about the head rather than the laparotomy sheet, great excess of which must hang over the head of the table. Of course, if one cared to do so she could provide short sheets made on the principle of the laparotomy sheet for such cases, and if many such operations are done this might be advisable.

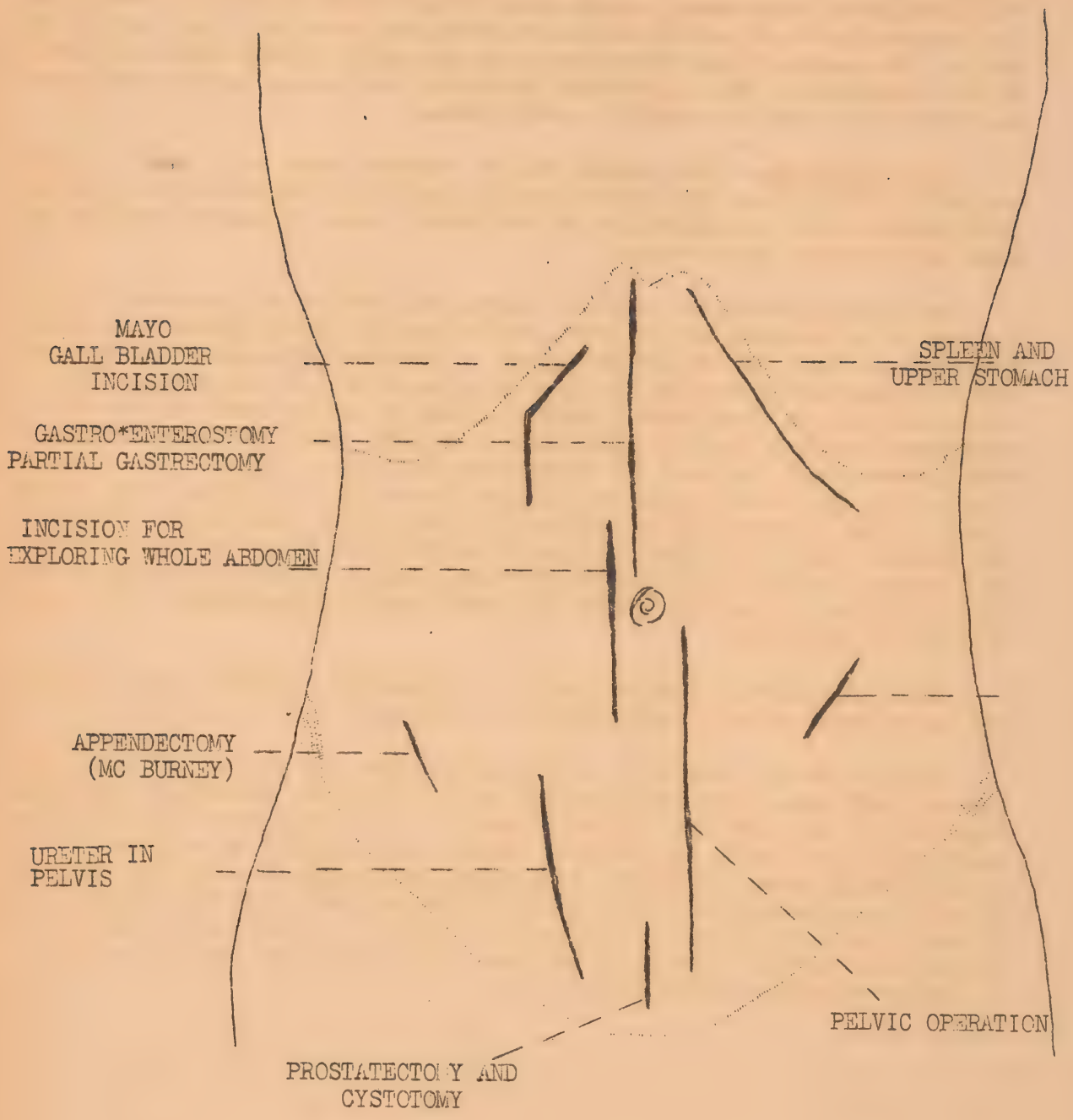
Neck Positions. The sandbag and the rubber sheet will always be used as for the head cases, but the head will usually be thrown farther back, particularly when the operation is for goiter; and, of course, well to one side for cervical gland cases.

As in all operations about the head, the problem of isolating the anesthetist is an awkward one to solve, but where the Kocher guard is available it may be so bent and draped as to make a technically perfect arrangement and a reasonably convenient one for all concerned. In this case, after the neck has been sterilized a sterile sheet is passed under it and the shoulders; another sheet is then thrown over the patient's body and the edge passed about the neck and clamped at the back. A third sheet is then thrown over the Kocher guard and clamped about the neck also. This latter clamp is best adjusted by an unsterile person on the anesthetist's side of the guard. There are other designs of guard which are very suitable for this purpose of isolating the anesthetist, but it is not necessary to enumerate them, for if one can adjust the Kocher guard satisfactorily the others will not be puzzling.

When the guard is not available the procedure described for face cases may be followed with the addition of the towel.

When there is a separate anesthetizing room the preparation and draping are best done there and the table rolled into the operating room fully prepared for the surgeon. It will thus be seen that convenience will require that the sterile preparation and draping supplies be stationed in the anesthetizing room. With the drum system this will be easy, but otherwise it will be necessary to have a sterilely draped table for the purpose; or, if conditions do not make this possible or safe a small stand which is easily carried may be prepared for each individual case and carried into the preparation room each time.

ABDOMINAL INCISIONS



Chapter XII

ABDOMINAL INCISION

All incisions through the anterior wall considered from the standpoint of layers cut through, suture material used, etc., are practically the same. The abdomen is prepared and draped in the usual manner.

The operator incises the skin and subcutaneous fat with a knife. Many small arteries are cut. The blood is sponged away with 4" x 4" sponges and the bleeding points clamped with artery clamps. The knife which has been used up to this point is "dirty." It is grasped through a gauze sponge by the nurse and put aside. In most clinics, towels are now adjusted so as to cover completely all exposed skin. The nurse places five towels from the reserve table upon the patient just in front of the instrument tray. The operator and assistant each take a towel unfold it until it is folded only once lengthwise and place it parallel to the edge of the wound. Two towel clips are placed one on each side, so as to catch the towel and the incised skin at about the middle of the wound; two towel clips are placed at each angle of the wound to catch each towel individually and the edge of the wound, or both towels and the angle of the wound may be grasped with one towel clip. The other two towels are unfolded and placed transversely at the upper and lower angles of the wound so as to cover the towel clips. This precaution prevents sutures, abdominal pads, etc., from catching the towel clips during the course of the operation. The fifth towel is then opened and placed flat across the patient in front of the instrument tray.

All exposed skin being covered, two sharp retractors are placed so as to hold back the subcutaneous fat and expose the fascia. This is cut either with a knife or a straight Mayo scissors. The muscle is now exposed and it is cut or separated in the direction of its fibers or else it is drawn aside as a whole with a blunt retractor.

The properitoneal fat and peritoneum are thus exposed. With a smooth or mousetooth forceps the surgeon and his assistant lift up the peritoneum opposite each other, being careful not to catch any intestine in their forceps. The peritoneum is incised with a knife or scissors. As soon as the peritoneum is opened the operator and his assistant each grasp the edge of the opening with a Kocher clamp. The incision in the peritoneum is extended upward and downward for the full extent of the wound, with straight scissors. Some operators do not apply the towels to cover the exposed skin, until the peritoneum is opened. Single retractors or a self-retaining retractor, is placed in the wound, wet abdominal pads are placed in the abdomen to wall off the intestines, and the surgeon proceeds with the operation.

Some men prefer to attach the towels to the skin with towel clips away from the cut edge of the wound. They then make their incision and on opening the peritoneal cavity, place two large laparotomy pads, one on each side, to cover the raw edge and exposed skin. Just the edge of the laparotomy pad projects into the peritoneal cavity. The self-retaining retractor is placed in the wound and the surgeon proceeds with the operation.

CLOSURE OF THE ABDOMINAL INCISION.--When the operation is finished, the first layer of the abdominal wall to be closed is the peritoneum. The edge of the wound in the peritoneum is grasped by several clamps. All abdominal pads are removed and counted! The operating room nurse must be absolutely certain that all abdominal pads are out before the peritoneum is closed. She should as routine notify the operator when he begins to close the peritoneum as to the number of pads to be accounted for or state "all pads out."

METHOD OF COUNTING ABDOMINAL OR LAPAROTOMY PADS AND SPONGES.—In every laparotomy drum there are six large and six small laparotomy pads. In case this is not enough, more pads are given the sterile nurse. These come wrapped in packages of six.

UNDER no circumstances should the nurse accept anyone's word for the number of pads in the drum or in the packages. She must count the number of pads she removes from the laparotomy drum verifying the fact that there are twelve; when more are needed and she is given a package of pads, she must promptly count and verify the number. The operating room nurse must remember how many packages she uses; in some hospitals the utility nurse marks on a blackboard the number of packages of pads she gives the operating room nurse thus making a double check. When the operation is finished the operating room nurse, knowing the number of packages opened, can by counting the number of unused pads on the reserve table, tell how many pads should be recovered from the patient. In some clinics they place all pads removed from the patient on a rack or stand--each pad separately--so that the sterile nurse can tell, at a glance how many pads have been recovered and if her pad count is correct.

The sponges are counted in a similar manner. Each sponge as it is discarded is placed upon the rack by the utility nurse, one sponge to a pin. The operating room nurse knowing how many packages of twenty-five sponges she has opened and counting the sponges she had left, can, with a glance at the rack, immediately tell if the sponges are all accounted for.

The operator closes the peritoneum with #0 plain catgut full length, threaded double, tied at the end, or #1 plain catgut cut in two, single, on a fairly large Mayo needle with a needle holder. The peritoneum is usually closed by a continuous suture. If the incision is a particularly long one, two or more sutures may be used. The next layer to be closed is the muscle. The fascia and subcutaneous tissues are retracted and the muscle is approximated with interrupted plain catgut sutures #0 or #1 cut in two, threaded on a Mayo needle, the same size as that used for the peritoneum. If the muscle has been drawn aside as a whole, it requires no suture.

The fascia is now ready to be closed. Sharp retractors are placed in the skin and subcutaneous tissue and the fascia is sewn with #1 full length, double, tied at the end of #2 chromic catgut cut in two, threaded on a Mayo needle. Most operators interrupt their fascial suture once, to prevent the entire fascial wound from opening, if the knot gives way. If the fascia is under any tension the suture may be interrupted three or four times. Occasionally, in the closure of upper abdominal wounds, the tension is so great that the fascia may have to be sutured for a short distance to relieve the strain, before the operator can proceed with the closure of the peritoneum.

After the fascia has been sutured, the towels and clips are removed, two clean towels from the reserve table are given the operator, who places them so as to cover most of the exposed skin. Some operators apply "skin sterilizer" to the skin edges before beginning the skin closure. The second assistant is given two skin hooks, which he places in each angle of the wound and holds the wound "on the stretch." The operator sews the skin with some non-absorbent material such as silk, silkworm gut or horse-hair threaded on a cutting needle, spear point or Hagedorn, straight or curved according to his

desire. When silkworm gut is used, one may, in order to prevent it from cutting into the skin of the patient, thread a small piece of rubber tubing, as long as the abdominal wall is thick, over the end of the silkworm gut.

There are several other methods of preventing the retention sutures from cutting the skin, such as—tying over a gauze bolster, or placing the suture through rubber tubing and tying the sutures on the tubing. Silkworm gut sutures are interrupted, three to five being used for the ordinary wound. Sometimes a continuous black silk suture is used for the approximation of the skin edges. When this is done the silkworm sutures are not tied until after the silk has been inserted.

Some operators use a heavy silk suture for their retention stitches. These are applied as a figure of eight stitch, placing the suture through the fascia first and then penetrating the skin from within out. Each needle, once it has penetrated the skin, being regarded as "dirty," is discarded. If this technic is used eight skin needles are required.

Dressings from a dressing package are applied to the wound.

In the lower abdominal wounds the application of collodion to the skin just above the upper and just below the lower edge of the wound before applying the dressings has proven very efficacious in preventing external contamination.

These dressings are held in place by several long strips of adhesive or by the application of an adhesive corset.

ADHESIVE BINDER.—The adhesive corset is made in the following way:

Material:

1. Two pieces of adhesive 9" x 12" covered by its original backing.
2. Two pieces of cardboard 9" x 1".
3. Twelve shoe eyelets and punch and an eyelet inserter.
4. Sheet wadding.
5. One yard of narrow tape.

Method:

1. The adhesive is laid flat on the table with the 9" side towards you.
2. The backing is removed for a distance about two inches.
3. The piece of cardboard is laid on the adhesive one inch from the edge with the nine inch sides parallel. The one inch edge is now placed over the cardboard so as to completely cover it.

4. The backing of the adhesive is now loosened through-out and re-applied leaving a raw area of about three and one-half inches. Sheet wadding is then applied to this area, (so that the adhesive does not stick to the dressing). The backing is not torn away but left long, so that it may readily be removed before applying.

5. This is now turned over and six openings are made in the adhesive covered cardboard beginning $\frac{1}{4}$ of an inch from the edge and being 1-3/4 inches apart. Into these openings the eyelets, are inserted and clamped in place by an eyelet inserter.

6. Vents, may be cut into the binder if desired.

7. One piece of narrow tape one yard long is tied to the lowermost eyelet and two of these prepared binders are rolled together and placed aside for future use.

The advantages of the adhesive corset binder are:

1. Saving in material as no further adhesive dressing need be applied.

2. Absence of pain with dressings as no adhesive must be removed.

3. Ease with which wound can be inspected.

4. Even pressure gives patient considerable comfort.

5. In case of marked distension corset can be readily loosened and thereby give the patient more comfort.

After the adhesive or the adhesive binder is applied the patient is transferred to the stretcher and an abdominal binder is applied. In some hospitals they place post-operative sandbags on the patient's abdomen under the binder.

SUTURES FOR THE ABDOMINAL INCISION.

For Peritoneum:--Plain catgut #0 full length on a large size Mayo needle threaded double or plain catgut #1 cut in two on the same needle.

For Muscle (if sutured):--Plain catgut #1 cut in two, threaded on the same size Mayo needle.

For Fascia:--Chromic catgut #1 full length double or #2, cut in two, on the same size Mayo needle.

For Skin:--Silk, silkworm gut or horse-hair threaded on a large straight or curved cutting needle.

These sutures should always be prepared before any laparotomy is begun.

OPERATION "POINTERS"

1. The knives and scissors should always be sharp.

2. Never give more than one clamp at a time.

3. Test all artery clamps and make sure that they work easily.

4. Never let the end of your suture drag over the table.

5. Always give the end of the suture to the first assistant when you give the operator the threaded needle.

6. Always have another suture ready just like the one used.

7. Never change the size of the needle unless the operator asks you to do so.

8. In threading a curved needle with its eye anteroposteriorly, always thread it from the concavity to the convexity. This makes it more difficult to unthread as the thread must go around a corner to come out.

9. Verify the pad and sponge count before the peritoneum is closed.

10. After an instrument has been used, clean it and replace it on the tray.

All Drawings

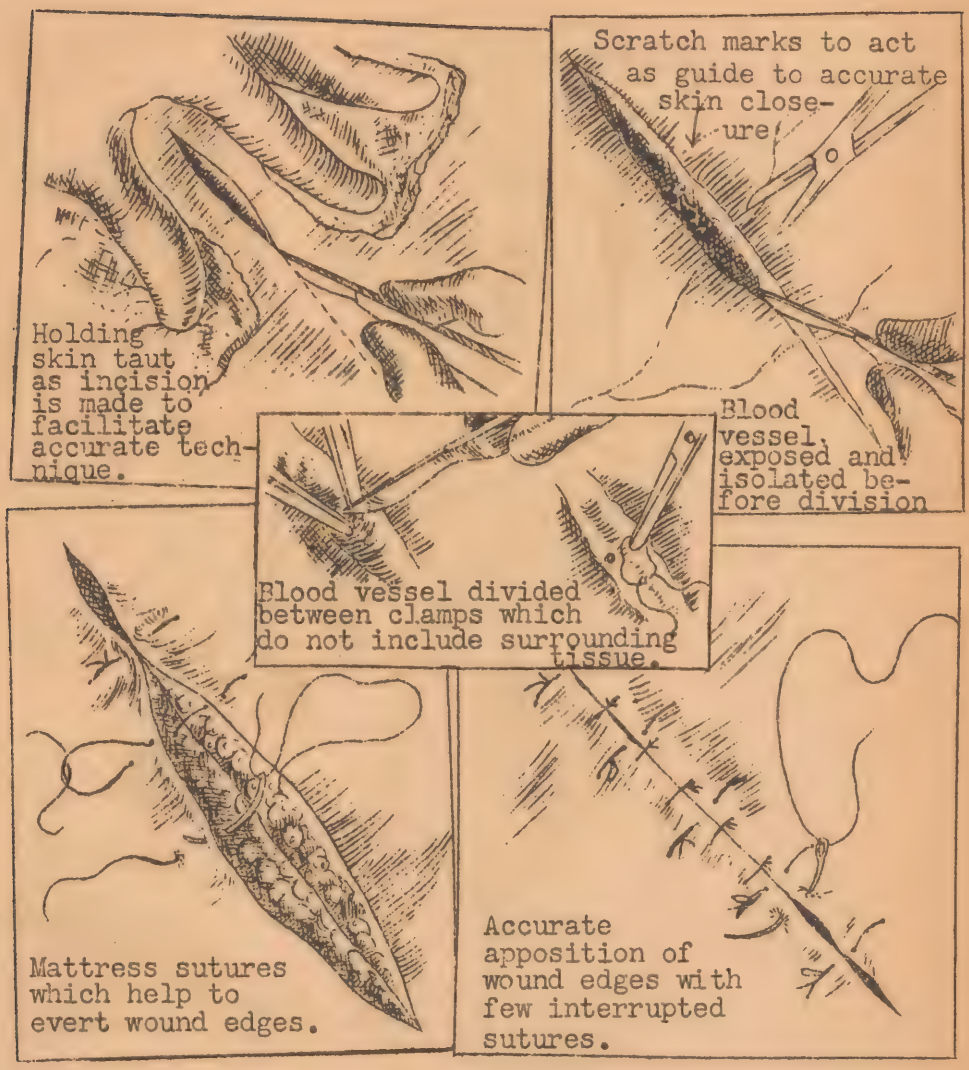
of Operations by

Permission

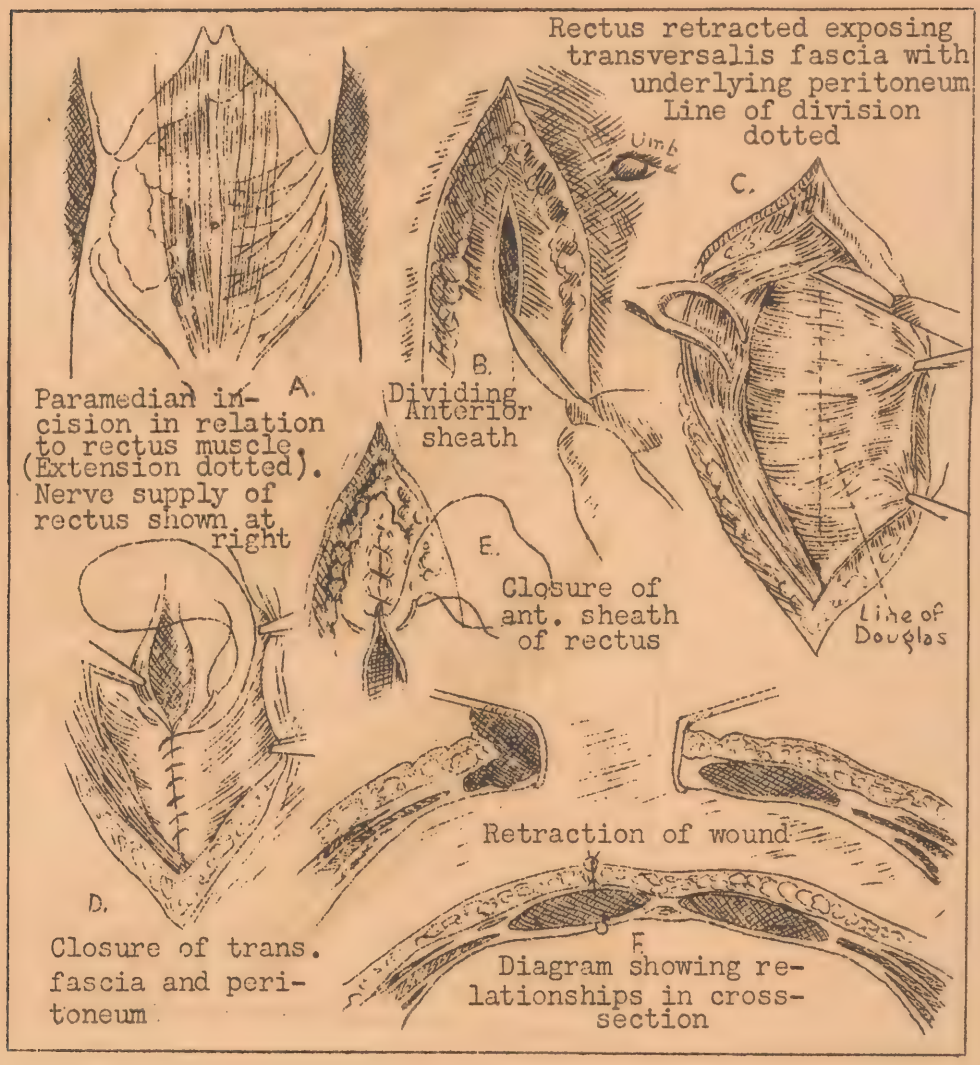
of

Johnson and Johnson

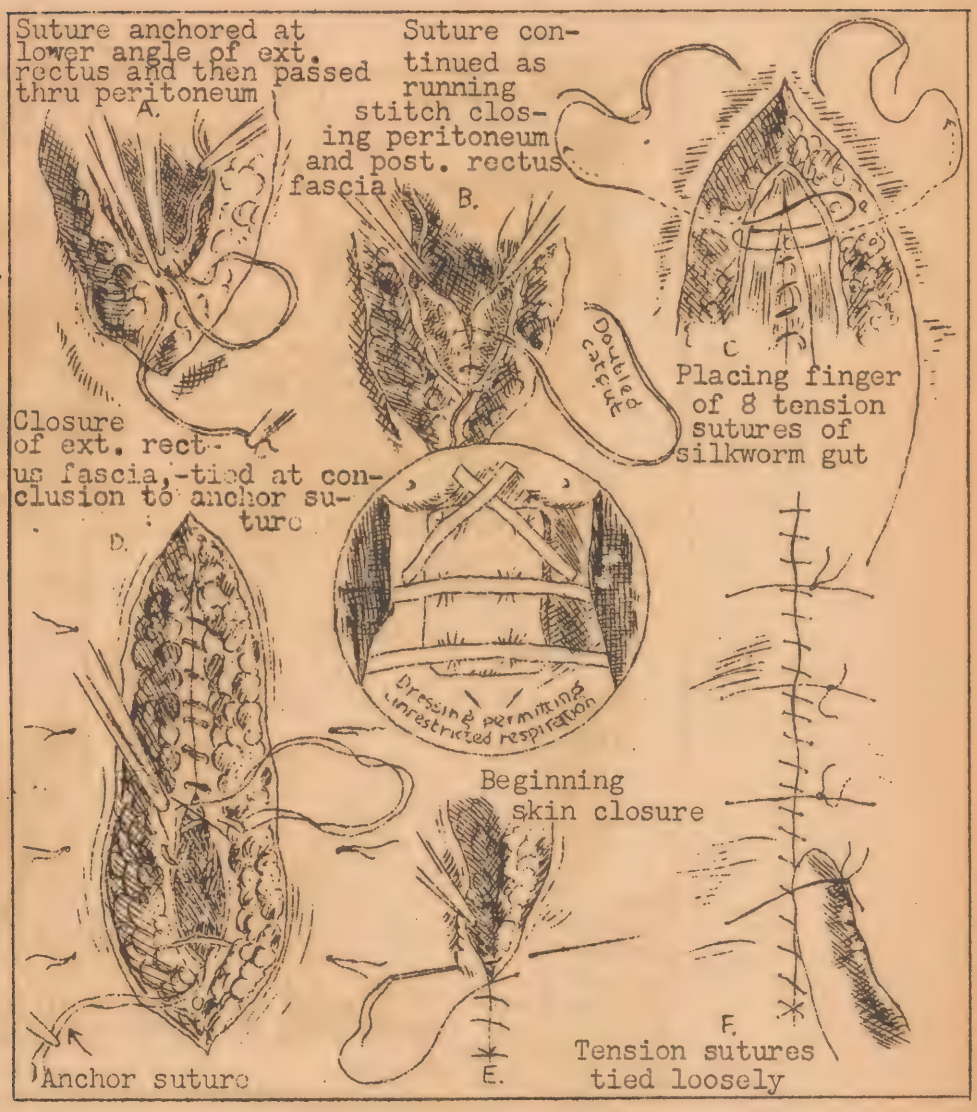
(Special Service School File 073.)


Holding skin taut as incision is made to facilitate accurate technique.
Scratch marks to act as guide to accurate skin closure.
Blood vessel exposed and isolated before division
Blood vessel divided between clamps which do not include surrounding tissue.
Mattress sutures which help to evert wound edges.
Accurate apposition of wound edges with few interrupted sutures.

PARAMEDIAN INCISION FOR LAPAROTOMY



CLOSURE OF RECTUS INCISION

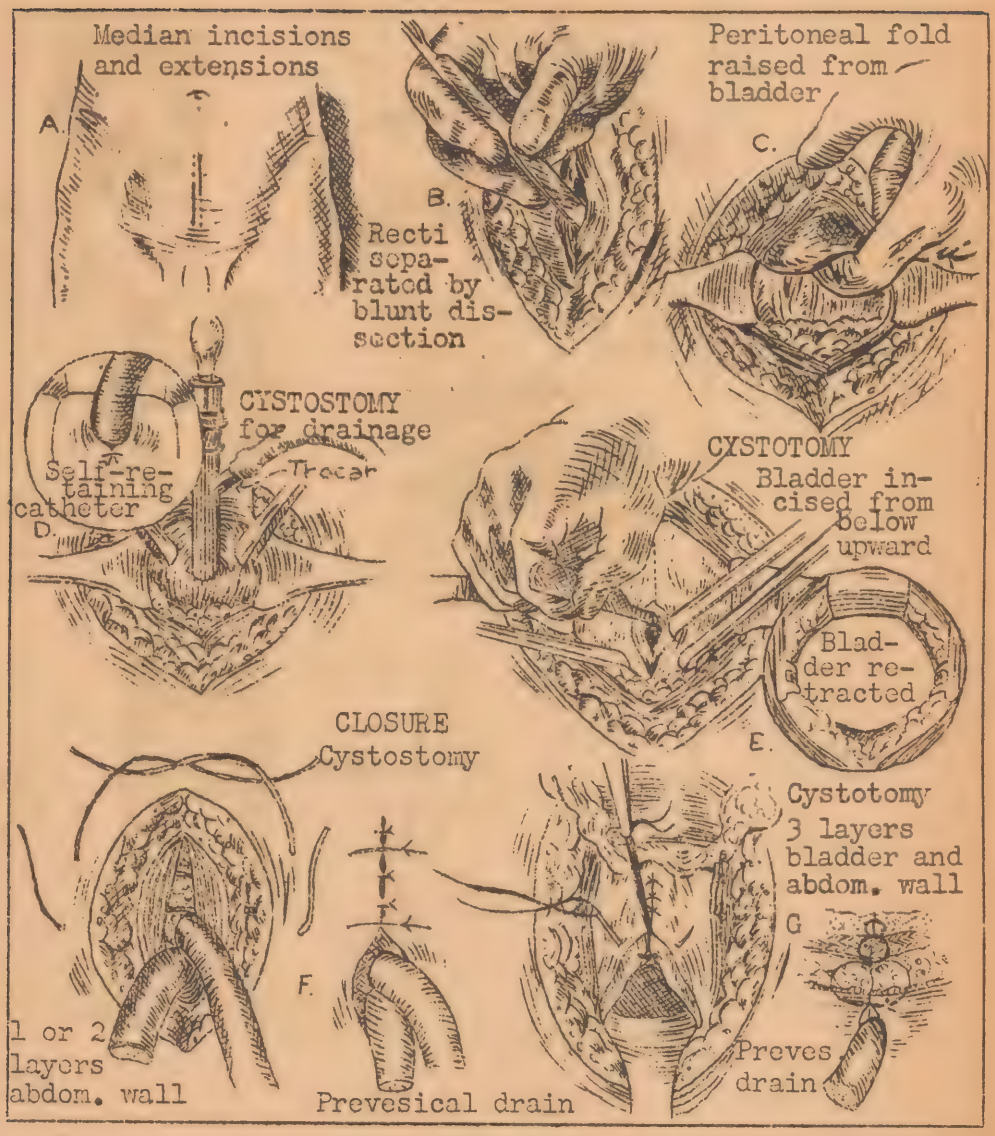


BASSINI OPERATION FOR INDIRECT

INGUINAL HERNIA

SUPRAPUBIC CYSTOSTOMY

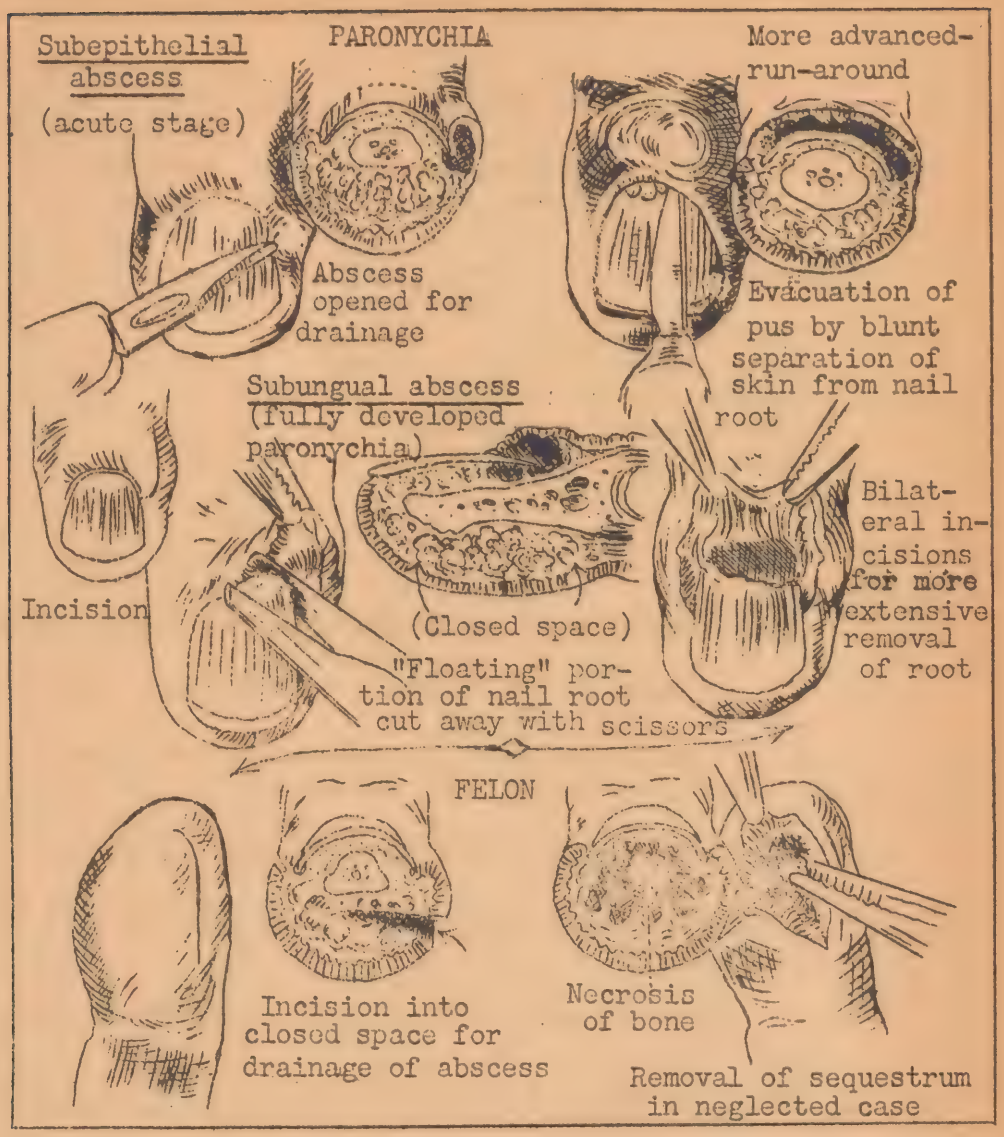
AND CYSTOTOMY




Clamp to protect glans
Retracted outer layer
Retracted prepuce cut off in line parallel with corona
Inner layer trimmed to within one cm. of corona
Alternate stitches of layers left long to include strip of vasalined gauze
Desired result; partly covered glans
SECOND METHOD
Cut
Adhesive
Probe
Dorsal split. (Continuous suture of layers)
Vasalined gauze dressing
If adherent, prepuce separated from glans

SURGICAL TREATMENT FOR PARONYCHIA

AND FELON



Chapter XIII

APPENDECTOMY

Definition--Removal of the Appendix.
Appendectomy for Chronic Appendicitis.

Preparation of the Patient. The usual preoperative preparation as for any laparotomy is given. The abdominal wall is painted with "skin sterilizer" from the right mid-axillary line to the left mid-axillary line, and from four inches above the umbilicus, down to a line from the symphysis pubis outward, below the anterior superior spine.

Instruments:

Basic instruments
Small self-retaining retractor
Suction tip and tubing
Deep abdominal retractors
Appendix Spoon
McBurney Retractor

Sutures:

1. Pagenstecher lien on straight and curved intestinal needles.

2. Aneurysm needle threaded with #2 plain catgut cut in three.

3. Plain catgut #1 or #0 cut in two, on a curved intestinal needle, for the re-enforcing stitch.

4. Plain catgut #1 cut in four, for ligatures.

5. Chromic catgut #2 cut in four, for ligating the base of the appendix.

6. Usual sutures, for the anterior abdominal wall.

Reserve Table. A medium sized square basin is placed on the reserve table. This is called the "appendix basin" and into it are placed:

1. A medicine glass with a small amount of pure carbolic acid.

2. Two moist gauze squares, or one moist 4" x 4" square split half way down the middle.

3. A medicine glass containing a small amount of alcohol.

4. A wooden applicator with a small piece of cotton twisted upon it, which is to be moistened with alcohol.

Into this basin are placed, after use, the dirty instruments, and the specimen - the dish is then discarded as unsterile.

Position on the Table - Dorsal.

Draping of the Patient. Same as for any laparotomy. Have the opening of the laparotomy sheet over the right lower quadrant of the abdomen.

Steps in the Operation.

McBurney Incision:

Step 1. Incision. In male patients when the diagnosis is unquestioned and occasionally in young females under the same conditions, a McBurney incision is used. A three-inch cut is made through the skin and subcutaneous tissue. This incision begins at a point one inch above an imaginary line drawn from the anterior superior spine to the umbilicus, and crosses this line at the junction of the outer with the middle third. It is a diagonal cut, running downward and inward, in the direction of the fibers of the external oblique muscle. The knife with which the skin incision was made is put in the appendix basin and is regarded as being unsterile. All bleeding points are clamped. Towels and towel clips are applied. With a fresh knife the operator nicks the external oblique fascia. The edges of this opening are caught with mousetooth forceps, and with a straight Mayo scissors, the fascia of the external oblique muscle is split in the direction of its fibers, for the entire extent of the skin incision. Two blunt retractors are inserted to hold back the edges of the fascia, exposing the fibers of the internal oblique which runs approximately at right angles to the incision in the external oblique.

Step 2. By blunt dissection, usually using the scissors and fingers or forceps, the operator separates the fibers of the internal oblique and transversalis muscles. The blunt or the McBurney retractors are introduced into this opening so as to expose the underlying peritoneum.

Step 3. The peritoneum is lifted between forceps and incised either with knife or scissors. As soon as the peritoneum is opened, the edges of the opening are grasped by two clamps. The small opening is enlarged with a straight scissors for the entire extent of the wound. The blunt retractors are now inserted into the peritoneum and the surgeon is ready to search for the appendix. (See Step 4.)

Closure of the McBurney Incision. The internal oblique and transversalis muscles are retracted and the edges of the peritoneum grasped by several Allis or Kocher clamps. The opening in the peritoneum is sutured with plain catgut #1 cut in two, on a curved round needle (Mayo) with a needle-holder. The separated fibers of the internal oblique and transversalis muscles are then brought together. These are usually sutured with two or three interrupted plain catgut stitches #1, on a Mayo needle. The external oblique fascia is then closed with a #1 chromic catgut, on a Mayo needle with a needle-holder. Clean towels are placed around the wound, the edges painted with "skin sterilizer" and the skin is closed with silkworm gut or silk.

Right Rectus Incision:

Step 1. Incision. Most operators use this incision, when there is some question about the diagnosis and an exploration may be necessary. The skin and subcutaneous tissue is incised one-half an inch medial to and parallel with the outer border of the right rectus muscle. It is begun one inch above an imaginary line joining the anterior superior spine with the umbilicus and extending two inches below it. This knife is placed in the appendix basin. All the bleeding points are clamped, and the towels and towel clips are applied. The skin edges are retracted with sharp retractors.

Step 2. The external layer of the rectus sheath is nicked with a knife. The cut edges of the fascia are grasped with mousetooth forceps and, with a straight Mayo scissors, the sheath is split the entire extent of the wound.

Step 3. The rectus muscle, which is now exposed, is either retracted medially, exposing the posterior layer of the rectus sheath (cammerer or Battle incision), or it is split in the direction of its fibers and held apart with blunt retractors exposing the posterior sheath of the rectus. This is lifted between forceps, incised with a knife, the edges are grasped with clamps and the wound is enlarged with straight scissors. The blunt retractors are now inserted and the surgeon is ready to search for the appendix. (See Step 4.)

Closure of the Right Rectus Incision. The rectus muscle is retracted with blunt retractors. The edge of the peritoneum is grasped by several clamps and the peritoneum is closed with plain catgut #0 whole length, double, or #1 cut in two, on a Mayo needle with a needle-holder. If the muscle has not been split, it is allowed to fall back into its bed and no sutures are used. If it has been split, its fibers are approximated by several interrupted plain catgut sutures #1 cut in two, on a Mayo needle with a needle-holder. The skin edges are retracted by two sharp retractors, exposing the cut anterior layer of the rectus sheath. This is closed by a continuous chromic catgut suture, #0 whole length, double or #1, cut in two, on a Mayo needle. All bleeding points are ligated with plain catgut #1, cut in four, and the clamps removed. Clean towels are placed around the wound, the edges painted with "skin sterilizer" and the skin is closed in the usual manner.

Step 4. Isolation of the Appendix. The caecum is found and its longitudinal bands followed down until we reach the base of the appendix. When this appears, the mesentery of the appendix is grasped with an Allis clamp, and the appendix is delivered into the wound. The mesentery of the tip of the appendix is also grasped with an Allis clamp. The caecum is then returned to the abdominal cavity, and a small abdominal pad is introduced to wall off the intestines from the operative field.

Step 5. Ligation of the Mesentery. Plain catgut #2 cut in three, on an aneurysm needle, is used to ligate the mesentery which is cut close to the appendix. Two or more of these aneurysm needles threaded with plain

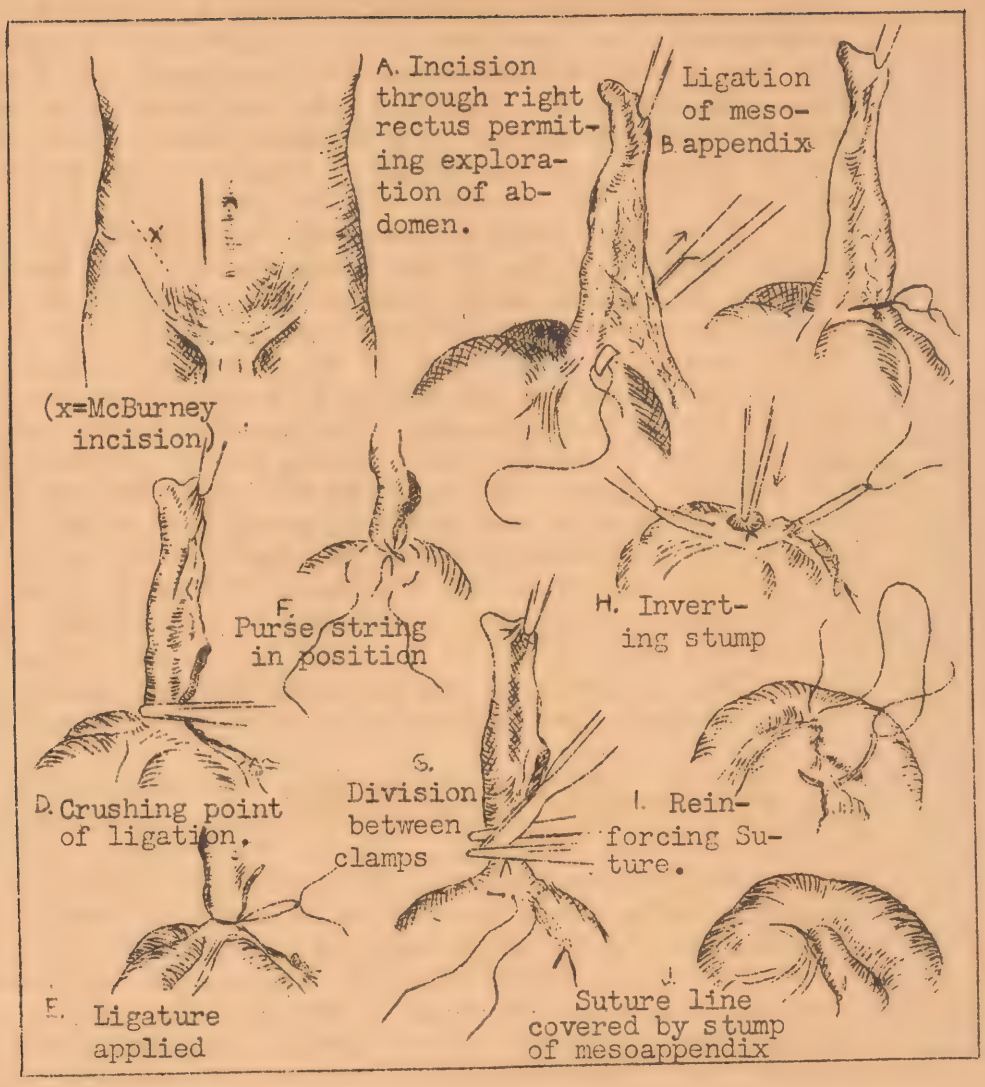
catgut #2, cut in three, may be required, according to the length of the mesentery and the number of adhesions. "Always have another ready." After the appendix has been freed of its mesentery down to its base, it is ready to be removed.

Step 6. Removal of the Appendix. A purse-string suture of Pagenstecher linen, on a straight intestinal needle, is inserted in the caecum, about one-quarter of an inch away from the base of the appendix. This suture goes through the submucosa but does not enter the lumen of the bowel. If the caecum cannot be delivered into the wound or it is under tension, a curved intestinal needle on a needle-holder is used to insert the purse-string suture. A Kocher clamp is placed on the appendix, about one-quarter of an inch from the caecum. The appendix basin is placed on the instrument tray. The Kocher clamp is removed, the appendix is ligated with chromic catgut #2 cut in four, at the point where it has been crushed. The Kocher clamp is re-applied about one-quarter of an inch distal to this ligature. The two sponges - moistened with saline -, are then placed on either side of the appendix, or the 4" x 4" split sponge is used. The chromic ligature is then cut short and the appendix is grasped by the spoon clamp in the same groove as the ligature. The appendix is cut across between the Kocher clamp and the ligature with a knife, dipped in the pure carbolic acid in the medicine glass. The appendix with the attached clamp is placed in the basin. The blade of the knife is again dipped into the pure carbolic acid, and its tip is introduced into the lumen of the small remaining portion of the appendix distal to the ligature. The knife is then placed in the appendix basin. The cotton applicator is dipped into the medicine glass containing the alcohol and it is given to the operator. He applies it to the base of the appendix, so as to neutralize any excess of carbolic acid that may be present. The applicator is placed in the appendix basin.

Step 7. Inversion of the Base. The base of the appendix is grasped with smooth forceps, the spoon is removed and the stump is inverted into the lumen of the intestine. The smooth forceps which grasps the base of the appendix and inverts it, is regarded as unsterile and is placed in the appendix basin. With the inversion of the appendix, all areas are again sterile, and the appendix basin is removed and given to the utility nurse. Never put your fingers inside the basin. The assistant helps in the inversion, by holding the edge of the intestine with the smooth forceps opposite the end of the linen thread. The linen suture is tied, and the suture of #0 plain catgut cut in two, on a curved intestinal needle, is used as a re-enforcing stitch.

Some men do not ligate the base of the appendix. They simply apply two Kocher clamps and cut the appendix between the two clamps. The proximal end is carbolized, neutralized with alcohol and then grasped with a smooth forceps and inverted. Other men do not use carbolic for the sterilization of the stump. Instead, they use the actual cautery. Where this is done, the operator wears a cautery bag, over his gloved hand or the cautery handle covered by a sterile towel. The nurse must see that the cautery cord does not touch the operator's arm. When the operator is finished with the cautery, the nurse grasps the cautery cord close to the cautery. The operator allows the cautery bag or towel to drop. In this way, the possibility of becoming contaminated is reduced to a minimum.

Step 8. The abdomen is then closed as previously described.


A. Incision through right rectus permitting exploration of abdomen.
B. Ligation of mesoappendix
(x=McBurney incision)
C. Purse string in position
D. Crushing point of ligation.
E. Ligature applied
F. Division between clamps
G. Inverting stump
H. Reinforcing Suture.
I. Suture line covered by stump of mesoappendix

Chapter XIV

TRANSFUSIONS

The transferring of blood from one person to another. There are two methods of transfusions, the direct and the indirect method.

The direct method consists of obtaining the blood from the donor (the person from whom the blood is taken) in a specially constructed syringe and injecting it into the recipient's (the person who receives the blood) vein so rapidly that it has no time to clot.

The indirect method consists of obtaining blood from a donor into a receptacle and adding Sodium Citrate 2-1/2% to it to prevent it from clotting and then injecting this prepared blood into the vein of the recipient.

Sodium Citrate Solution for blood transfusions (indirect method) 10 cc. of a 2-1/2% solution is added to every 100 cc. of blood taken from the donor.

Sodium Citrate combines chemically with the calcium salts of the blood thus preventing it from clotting.

Reasons for giving Blood Transfusions.

Blood transfusions are given to persons for various reasons. Persons suffering from pernicious anemia receive blood transfusions because there is a deficiency of erythrocytes (R. B. C.). This deficiency of erythrocytes will not allow the blood to supply the cells of the body with sufficient oxygen, or remove the waste products formed by metabolism.

Blood transfusions are also given to persons who have lost a lot of blood due to severed veins or arteries. They are also given to persons undergoing an operation in which there will be a considerable loss of blood.

Blood is given in cases of severe shock, as of, peritonitis in which it enriches the blood supply, enablying it to build up resistance to the invading organisms.

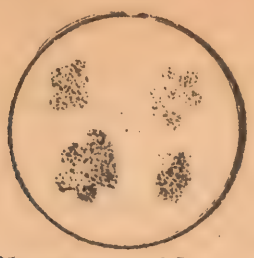
Compatibility.

In giving a blood transfusion the donor's blood must be compatible with the recipient's blood. If it is not, it will agglutinate the corpuscles which will block the small blood vessels and cause death.

Blood Groups.

As a result of a large series of blood-studies, it has been found that they could be classified into four groups, called Types I, II, III, IV, (Moss).

Diagram showing all types of blood from the standpoint of the donor and recipient.



Noncompatible

Compatible

Before giving a transfusion it is therefore necessary to know what type the recipient is, select the proper donor and then cross agglutinate the two bloods so as to make doubly sure that they match.

TECHNIQUE FOR TYPING BLOOD

1. Take 1 cc. of patient's blood in a dry sterile syringe.

2. Put 3 drops of blood in a small test tube containing 1 cc. of a 2% solution of Sodium Citrate in a normal saline solution.

3. Put the remainder into a dry test tube and allow the blood to clot on a slat in order to collect and preserve the serum.

4. Take two concave slides and two cover glasses, clean and dry very carefully.

5. Mark slides plainly II, III, respectively.

6. Deposit two loopfuls of known serum type II on the coverglasses. (Flame and cool loop (platinum loop) after each step.)

7. Emulsify one loopful of citrated blood mixture in the drops of Type II serum on the cover-glass.

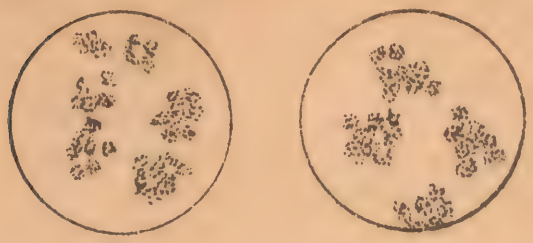
8. Repeat this procedure with Type III serum, making a hanging drop in each case.

9. Put vaseline around edge of concavity on slide and place slides over the respective cover-glasses. Turn slide over in such a manner as to make serum and saline act as a hanging drop on the cover-glass.

Readings and their interpretation in diagram.

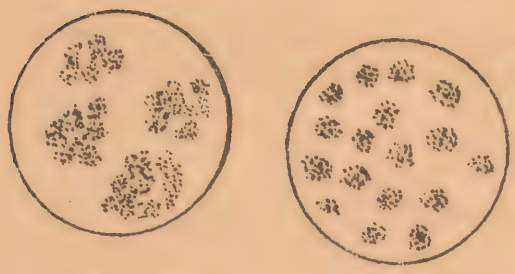
Appearance of both slides Type II - Type III serum fifteen minutes after examination was begun and their interpretations.

Type II Serum Type III Serum

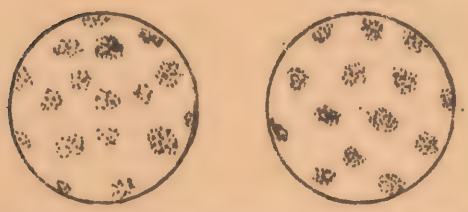


If the cells on both slides are clumped together then the blood is incompatible to Blood Type II and Type III, thus we have Type I blood.

If the cells are clear and freely circulating on Type II slide, but clumped on slide Type III, then we have Type II blood.



If the cells are clumped on Type II slide, but freely circulating on the Type III slide, then the blood is Type III.



If there is no clumping on either slide then we have a Type IV blood.

After having ascertained the blood type of the recipient, a donor of the same type is obtained. Then in order to be absolutely sure of the compatibility of the patient's serum to the donor's red blood cells, the donor's cells are matched with the patient's serum.

Cross-Matching for Compatibility of Recipient and Donor.

1. Deposit one loopful of patient's serum on the cover-glass.

2. Emulsify in this, one drop of the donor's citrated saline blood.

3. Make a hanging drop on a cover-slip and examine under low power lens of microscope.

4. Report after 45 minutes. Tilt the slide from side to side every five minutes.

5. Interpretations: If there is no agglutination, accept as a donor. If there is agglutination (clumping) reject.

Precautions.

1. Use only perfectly clean and dry glassware.

2. Flame and cool loop after taking and depositing each drop.

3. Tilt the slide several times from side to side during observation.

4. Use known Type II, Type III sera.

After the foregoing procedures have been carried out and a suitable donor is found, we are ready to make the transfusion.

SET-UP FOR TRANSFUSION PACK

1 - Wire basket for instruments.
6 - Towels.
1 - 500 cc. glass graduate.
1 - Glass funnel, wrapped with gauze.
1 - Glass stirring rod.
1 - 10 inch rubber tubing.
1 - Leur adapter.
1 - 30 cc. Leur syringe.
1 - 2 cc. Leur syringe.
3 - Large needles #17-18-19.
1 - Small needle for injecting procaine. No. 23.
2 - Glass tumblers.
2 - Medicine glasses.
2 - Enamel cups.
6 - Sponge forceps.
1 - Dozen 4 x 4 dressings.

Also needed.

1 - Large basin.
1 - Flask of sodium citrate 2½% solution.
1 - Arm board.
Iodine or Merthiolate.
Alcohol.
Procaine.

x x x x x x x

ORTHOPEDIC SECTION

x x x x x x x

Chapter XV

DIAGNOSIS OF FRACTURES

The classical signs of fracture are generally described as

1. Pain at the seat of injury.
2. Deformity of the limb affected.
3. Mobility between the broken fragments.
4. Crepitus.
5. Loss of function of the injured limb.

Deformity or mobility between the fragments may make the diagnosis certain, but unless these obvious signs are present, one or more of the following points are depended on:

1. The history of acute and severe pain at the time of injury.
2. Localized tenderness on pressure at the seat of fracture.
3. X-ray examination.

The examination of the patient should be carried out in the gentlest manner, and no rough handling of parts allowed. The clothing should be removed with care. It is better, for example, to sacrifice a boot by cutting it off, if there is any difficulty in removing it, rather than further to complicate a fracture about the ankle by rough handling.

Unless crepitus is evident on gently handling the part, it is unnecessary and inadvisable to try to elicit it; its absence may be due to the impaction of the fragments. Crepitus has always been regarded as a classical sign of fracture, but in practice it is not of great diagnostic value. If bony crepitus is felt, this is evidence of a fracture, but the absence of this sign does not mean that there is no fracture. Crepitus is only felt with an obvious fracture, when no difficulty arises in reaching a diagnosis. In the many doubtful instances crepitus will not be elicited except by rough handling, and perhaps not even then. The sign is of little value, therefore, in the diagnosis of a difficult fracture.

The line of the fracture and its exact extent will only be revealed with certainty by X-ray examination. As this procedure is now universally adopted, and as no examination is complete in its absence, it is unnecessary to distress the patient by a prolonged physical examination.

It is not intended to convey that the essential evidence of the X-ray examination renders all other procedures obsolete; indeed, in the majority of instances, by gentle examination and measurements, one can make up one's mind with some degree of certainty from the clinical signs.

When the patient is not seen until several days after the injury, marked swelling, ecchymosis, and the formation of blebs, will be strong evidence of fracture. Swelling may in some degree mask deformity, noticeably in relation to injuries about the ankle joint.

LOCAL TENDERNESS ON PRESSURE. This is evidence of great value when the more classical signs of fracture are absent. Localized pain, severe in degree, produced by pressure over a definite area of the suspected bone, is strong evidence of fracture. This sign is most often of value in the following instances:

1. Impacted fracture of the lower end of the radius without gross displacement.

2. Linear fracture of the lower third of the fibula.

3. Fracture of the carpal scaphoid.

The site of maximum intensity of pain on pressure in an uncomplicated "sprain" is over the attachment of one or other of the ligaments of the injured joint; when there is a fracture, tenderness is located over the actual site of the break in the bone. Careful examination with this particular point in view will, in the majority of instances, materially assist diagnosis.

X-RAY EXAMINATION. We may consider the value of X-rays from three standpoints:

1. As an aid to diagnosis.

2. As a control during treatment.

3. From the medico-legal standpoint.

AS AN AID TO DIAGNOSIS. It should be undertaken as part of the routine examination of any patient in whom a fracture is regarded as a possibility. It is a necessary routine in all sprains and joint injuries, for it may be impossible to detect the bony lesion in a severe sprain complicated by a fracture except by the aid of a skiagram.

It is not sufficient to make a screen examination. Some fractures which do not show on the screen are clearly visible on a plate; and whilst positive evidence of fracture on screening is useful, negative evidence cannot be accepted as final.

The skiagrams should be taken from two points of view in planes at right angles to each other whenever the anatomy of the part admits. These two views are sometimes necessary to show the fracture at all, and are essential in order to gauge correctly the displacement of fragments. In certain parts of the body a stereoscopic examination is needed in order to see exactly what has happened; fractures of the spine of the tibia, and of the carpal bones may be instanced. Stereoscopic examination should be employed when the fracture is situated at the upper end of the humerus or femur.

When dealing with children it is occasionally necessary to administer an anesthetic in order to attain the immobility necessary for satisfactory radiography.

AS A CONTROL DURING TREATMENT. After the fracture has been "put up," further X-ray examination is needed, in order to make certain the position is satisfactory. It cannot be too strongly emphasized that the general practitioner should satisfy himself, both in his own interest and that of his patient, by means of radiography that subsequent to diagnosis the fracture has been "set" in a satisfactory position. For this reason, whenever possible, splints which are permeable to X-rays should be used. Skeleton splints, light bi-valved plaster of Paris splints, or splints made of aluminum fulfill these conditions. It is important that as far as possible, the splints controlling the fracture should not need removal for the examination.

Again for this purpose skiagrams taken in two planes at right angles to one another are necessary. A fracture may appear to be in perfect alinement when viewed antero-posteriorly and yet show gross deformity in the lateral view.

During the course of the repair of the fracture, further skiagrams may be taken in order to demonstrate the condition of the callus. This is unnecessary in most simple fractures of the upper limb, but is sometimes of considerable importance in the lower. It is particularly valuable with delayed union of the long bones. Callus which has not consolidated sufficiently to withstand strain presents a "fluffy" homogeneous appearance on an X-ray plate, and is tender on pressure. When it is consolidated, it becomes laminated, i.e., it takes on the normal trabeculated structure of bone; therefore, the X-ray evidence will assist in forming an opinion as to when it is safe to bear weight on a limb, or to give up the use of guarding splints.

It should be mentioned that the amount of callus thrown out varies greatly in different individuals and in different types of fracture. The apparent absence of callus in an X-ray plate taken a month or two after the injury does not necessarily mean that repair is not progressing, as it may be due to lack of calcium deposit in the granulation tissue.

FROM THE MEDICO LEGAL ASPECT. The practitioner will be well advised not only to have an X-ray picture taken of every suspected fracture, and of every patient in whom a fracture is a possibility, but he will also be wise to keep a copy of the skiagram, either the original plate or a print. This, together with notes taken at the time of his examination, will prove invaluable should the patient become involved in litigation as the result of the accident.

If the circumstances make it difficult to obtain an X-ray picture, the importance of the examination should be insisted on to the patient, and the responsibility for omitting the examination should be left to him. In the event of such refusal the doctor should obtain a written statement from the patient that he refuses to have an X-ray taken.

INJURIES TO OTHER STRUCTURES. For the completion of the diagnosis, for the efficacy of treatment, and again from the medico-legal aspect, any injury to other parts should be carefully looked for and noted both at the time of the original examination and at intervals afterwards.

The structures most commonly involved are:

1. Neighboring joints.

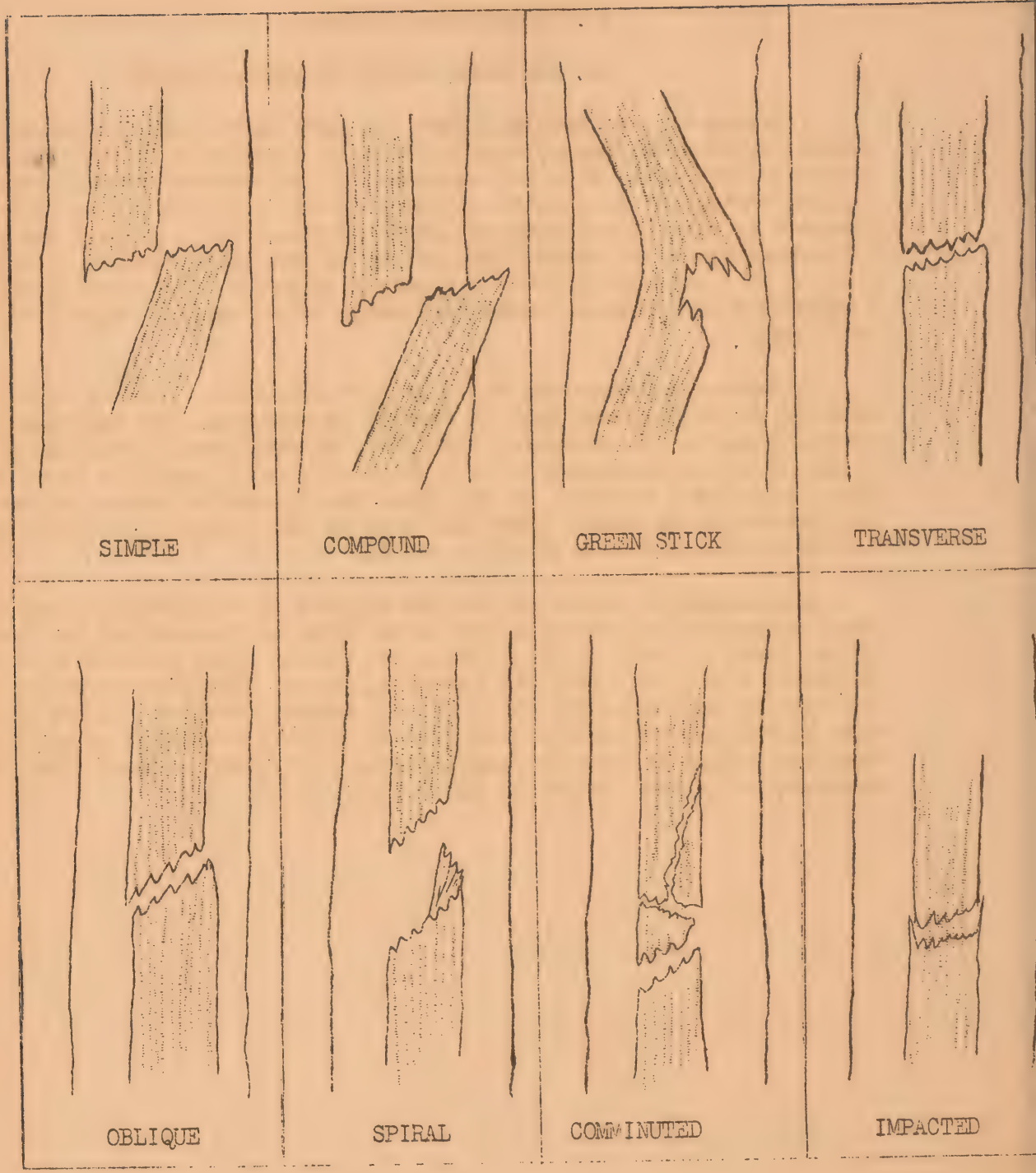
2. Adjacent nerves or blood-vessels.

Injuries to neighboring joints are more common than is sometimes supposed. Apart from those examples in which a definite dislocation complicates the fracture, as is not uncommon at the shoulder joint, bruising of a joint cartilage or a severe sprain is frequently met with. Pain in the shoulder is often complained of a week or two after a patient has sustained a fracture about the wrist; this is due to the trauma which, at the same time as it caused the fracture, produced bruising of the shoulder joint. A synovitis of the knee joint, similarly, often complicates a fracture of the femur.

Injuries to nerves may be partial or complete. Partial tearing or bruising is more common than is usually recognized. The musculo-spiral nerve, owing to its anatomical position, is sometimes injured in a fracture of the shaft of the humerus. Its function should always be investigated when examining a fracture of the arm. The circumflex nerve is sometimes paralyzed with fractures about the neck of the humerus, or in association with dislocation at the shoulder joint.

Less commonly, other nerves are injured by the fractured end of the bone; injury to the external popliteal nerve by fracture of the lower third of the femur or neck of the fibula, and to the ulnar and median nerves by fractures about the elbow are examples. Apart altogether from injury at the time of the accident, the nerve may become involved in, and pressed upon by callus; this may be met with in uniting fractures of the humerus, when the callus affects the musculo-spiral or ulnar nerves. Secondary involvement of nerves by callus is, however, rare.

FRACTURES


SIMPLE
COMPOUND
GREEN STICK
TRANSVERSE
OBLIQUE
SPIRAL
COMMINUTED
IMPACTED

GENERAL PRINCIPLES OF THE TREATMENT OF FRACTURES
FIRST AID

While it is desirable to reduce deformity and fix the fracture in good position at the earliest possible moment, in practice it frequently happens that the requisite apparatus and facilities may not be immediately forthcoming. Fractures occurring on the battle field and elsewhere call for "first aid" treatment, in order that the patient may be transported to his home or to hospital with the minimum of discomfort and with the least risk of complicating the injury. Fixation by improvised splints must be resorted to under such circumstances.

With a fracture of the lower limb it is generally advantageous to bind the broken to the sound leg, and, with a fracture of the arm or forearm, the latter should be supported in a sling and the arm bound to the chest.

During the War a system of "first aid" treatment for cases of fracture in the lower extremity was gradually evolved which had a marked effect in reducing shock and in saving life. Fixation combined with traction was the keynote. The use of the Thomas splint in ambulances and at aid posts for fractures of the femur produced an immediate improvement in comparison with the older methods with their less complete fixation. The splint was applied over the clothing and traction made from the boot.

Such splints as the Thomas knee splint should be readily available for the fractures occurring in civil practice, and a small supply (three sizes) should form part of the armamentarium of the practitioner, to enable him to deal with emergency fractures on reasonable lines and safeguard his patient during transport.

Reduction of Deformity

The ultimate functional result will depend to a great extent upon the correction of the displacement and adequate fixation. With fractures of the lower limb, no amount of after-care can compensate for faulty alinement. The disastrous results met with so commonly after a Pott's fracture are directly attributable to imperfect reduction of the deformity.

In the upper limb, a good functional result is sometimes compatible with a poor anatomical one, but this is no reason for neglecting the cardinal principle of complete reduction in the treatment of all fractures.

The displacement of the fragments after a fracture may be in one or more of the following directions:-

1. Overlap. Impacted or free.

2. Angulation, in any plane.

3. Rotation about the longitudinal axis of the limb.

4. Lateral displacement in relation to the central axis of the limb.

5. Separation - nearly always by muscle traction.

The practitioner who fails to reduce the displacement and restore the anatomical alinement of the limb will lay himself open to grave criticism.

When overlapping is present alone or in conjunction with one or more of the other varieties of displacement, the first step in the reduction is the correction of this overlap. The overlap is produced partly by the direction of the violence and partly by muscular contraction. During reduction the muscular contraction must be overcome, either by means of immediate forcible traction and manipulation with the aid of a general anaesthetic, or by means of steady continuous traction, exerted over a period of a few days.

In the case of a fracture which is first seen two or three days after the injury, the shortening, as a rule, cannot be overcome at once, owing to the infiltration of the muscles and soft parts by blood and exudate. Such shortening may be corrected by applying continuous traction for a few days, during which period any associated displacement can be rectified. A fracture of the shaft of the femur, with two or three inches of shortening due to overlap, may be instanced. Although it may not be possible to pull this out in one stage to full length, yet the application of a Thomas splint, with traction and counter-traction, will enable full length to be regained in a few days.

For the immediate reduction, with the intention of restoring length in one stage, in which pulling by hand is insufficient, some simple means of producing mechanical traction should be available. The more elaborate apparatus, such as an orthopedic table, is convenient but not essential. A block and tackle, will suffice. A jack towel passing round the groin and fixed to the head of the bed, or to a staple in the wall, acts as the counter-traction. Traction is made by a pull on the foot - the best attachment for this being a skein of worsted wool or a narrow strip of webbing.

It cannot be emphasized too strongly that all fractures should be reduced as soon as possible, and should never be left on a temporary splint for some days without any attempt at reduction being made. Delay is often advised to allow the swelling to subside, or to await the result of a skiagram; the disadvantages of this outweigh the advantages. An X-ray plate is highly desirable before an attempt at reduction is made, but, if for any reason this cannot be obtained, its absence is not a sufficient reason for postponing the attempt.

Fixation

The deformity having been reduced, it is necessary to fix the fracture to prevent recurrence of the displacement and to immobilize the fractured ends. The time-honored rule of fixing the joint above and below the fracture should not be rigidly adhered to, provided the hold on the fragments is otherwise effective. Prolonged rigid and extensive fixation of a whole limb is undesirable, and is responsible for stiff joints, atrophy of muscles and protracted convalescence.

Instructions are given when dealing with individual fractures as to methods of fixation and the time necessary before movement or weight-bearing may be permitted, but certain general considerations will be dealt with here.

The age of the patient has an important bearing on the length of time during which fixation can be used without ill effects. A normal joint in a child, when fixed, does not form adhesions. After an osteotomy for knock-knee in a child, the whole leg may be immobilized in a plaster of Paris cast for six weeks. A week or so after the cast is removed perfect mobility of the joints is regained. If the limb of an adult be similarly fixed, it will be a considerable number of weeks before there is freedom of movement in the joints, and this in spite of active physical treatment being employed to aid in the restoration of mobility.

Fixation is necessary in the treatment of the majority of fractures, but should always be retained for the minimum period. The rapidity with which consolidation and union take place varies within wide limits, and has already been discussed in Chapter III.

The variety of fracture also has a bearing on the degree of fixation necessary. In many fractures, when once reduced, there is little tendency to recurrence of displacement; fracture of the surgical neck of the humerus may be instanced. It is frequently possible to get the fragments to interlock, so that the arm can be brought down to the side, when a small pad placed in the axilla and a bandage holding the arm to the side, with a sling for the forearm are all that are needed to maintain the position.

An oblique fracture of the shaft of the femur, on the other hand, will need careful fixation, with traction and supporting splints for some weeks, if deformity is to be avoided.

During repair of a fracture, the granulation tissue between the fractured ends becomes converted into a mass of plastic callus. When this callus has formed, relaxation, but not omission, of the splintage may be permittted, provided it is clearly understood that, although union is sufficiently advanced to prevent recurrence of overlap, angular displacement is still liable to occur.

After the fragments seem to be firmly united on clinical examination, the callus remains plastic for some time; for longer than is commonly supposed. For this reason no undue strain should be allowed to pass through a limb until some months after fracture. Freedom of movement is a different thing. After a Colles' fracture, freedom of movement and removal of all splints are usually safe in from two to three weeks, but no heavy work should be done for at least eight weeks. In practically all fractures of the forearm, voluntary movements of the hand should be encouraged from the first while the splints controlling the fracture are kept in place. In the lower limb, while freedom of movement may be allowed six weeks after a fracture of the femur in some cases, weight-bearing should not be permitted for at least a further six weeks. Some form of ambulatory splint, of which the Thomas caliper is the cheapest and most convenient, should be worn.

There are two indications that the callus is firm enough to stand full strain. First, it ceases to be tender when pressed on or squeezed by the

hand, and, secondly, its X-ray appearance changes. There is evidence of lamination in the place of the blurred, homogeneous shadow shown by young callus.

Splintage

The term "splintage" applies to any apparatus designed to give support to a broken bone. Three types are well fitted for the purpose:

1. Gutter splints.

2. Skeleton splints.

3. Plaster of Paris splints.

1. GUTTER SPLINTS, made of sheet metal, are preferable to wooden splints. The latter can only fit closely in virtue of interposed padding and are difficult to fix on the limb. In practice, a padded wooden-back splint does not keep in position. The metal splints, being concave from side to side, are better suited for the purpose. If made of sheet iron, as generally recommended, they are impervious to X-rays, but they may be equally well made of aluminum, when they are no longer open to this objection. They can be bent to any required form, and, when so bent, have sufficient rigidity to maintain their shape. Care is needed in their application. They should be evenly bandaged on, after careful application of the padding with the limb in the position in which it will finally rest. Pain or an increase in swelling in the limb distal to the splint, coming on after its application, should always be regarded as a danger signal. When these signs are noticed, the splint should be removed and reapplied in such a way as to prevent the production of uneven or too severe pressure.

It should be noted that splints of this kind are able to control the alinement of the fracture, but have no value in maintaining fixed traction. They are also of service as an adjunct to a skeleton splint, acting as a support between the bars, and can be utilized to prevent angulation of fragments when traction is produced by the aid of a skeleton splint.

The small cock-up splint made from similar metal is of great use for certain fractures about the wrist.

2. SKELETON SPLINTS (a) The Thomas knee splint may be taken as a typical skeleton splint. When used as its designer, Hugh Owen Thomas, used it, it maintains the whole limb in a position of fixed traction. This traction is maintained by the fixation of the leg to the lower extremity of the splint, while the counter-fixation is secured by the back part of the ring fitting snugly against the tuber ischii. The proper action of the splint is dependent on the satisfactory maintenance of counter-fixation, and care must always be taken to see that the ring fits the thigh so that it will press against the tuber ischii and not ride up over it and press upon the perineum.

The limb is supported in the splint by flannel or linen slings, four inches wide, which are adjusted so as to hold it in the desired alinement about midway in the splint. The flannel slings are usually fixed to the side bars of the splint by safety-pins, but strong spring clips are more convenient for the purpose.

In the management of patients in which this splint has been applied, special care must be taken to prevent the formation of a pressure sore. Pressure over the ischium can be relieved by raising, lowering or abducting the limb from time to time. The skin under the ring should be kept dry and well powdered. The actual skin surface in contact with the leather can be changed from time to time by utilizing the normal mobility and elasticity of the skin and drawing it up and down.

The end of the splint should be supported on a special prop, or on a block, or a sandbag, to prevent pressure on the heel, and the foot may be supported at a right angle by means of a small gallows. The most convenient arrangement is to suspend the splint from a "Balkan" Frame or similar structure.

The Thomas splint may also be used on the Hodgen principle; that is to say—counter—traction is produced by raising the foot of the bed and utilizing the patient's body weight. This method obviates the necessity for a carefully fitting ring, as the tuber ischii no longer bears the pressure. The details of the application will be described in the section on individual fractures.

b. The Hodges Splint—This splint is a wire skeleton, bent at the knee, in which the lower extremity is cradled, as described for the Thomas knee splint. The leg is fixed to the lower extremity of the splint by means of a standard traction attachment - any pull applied to the limb being carried through the splint. The classical method of obtaining traction on the splint is to suspend it from a fixed point situated above and distal to the foot. The weight of the limb bearing on the oblique suspension cords will produce a long axis traction, which varies with the suspended weight and with the points of attachment of the cords.

Counter-fixation is obtained by raising the foot of the bed at least six inches. If this method be used, it will be found to require careful and continual adjustment if the position and traction are to remain constant. A simpler method of employing the splint is to suspend the limb in the flexed position in the splint from a "Balkan" frame, the required traction is then obtained by means of weight and pulley - the weight-cord being attached to the lower extremity of the splint. Instead of counter-fixation by means of the patient's body weight, or in addition to it, a perineal strap may be passed round the sound thigh and attached to the head of the bed on the same side. This appliance will be found to assist the maintenance of the position of abduction for the injured limb.

c. The Caliper splint is employed for ambulatory treatment when it is desired to prevent weight passing through the long bones or joints of the lower extremity. The principle of action is the same as that of the Thomas knee splint. The ring bears on the tuber ischii and carries the weight of the body; the lower ends of the caliper are clipped into sockets in the heel of the boot. The side members of the splint should be adjustable in length and, when clipped into place, they should hold the upper surface of the heel of the boot half an inch clear below the under surface of the heel of the patient. In this way the body weight is transferred direct from the pelvis to the ground, through the side bars of the splint - no weight passing through the skeletal structures of the lower extremity.

After the patient has worn the caliper for a day or two, he will probably sink a little into the ring and the side bars must therefore be lengthened in order to maintain the proper action of the splint. It is clear that the fit of the ring and the treatment of the surface upon which it bears are of the same importance with this apparatus as with the Thomas knee splint.

If there is no shortening of the affected limb, the heel of the boot on the sound limb must be raised three-quarters of an inch, as, otherwise, the patient will walk with the injured leg abducted.

3. Traction and Counter-Traction.

a. Methods of applying Traction.--(i) Adhesive strapping.--The skin should be shaved. Two strips of strapping are applied - one on either side of the limb - and should be sufficiently long to extend to the site of fracture above and to beyond the sole below. Over these are fixed two or three circular strips, which must not encircle the limb completely, and which should be applied preferably in the form of a spiral. No strapping should be placed in contact with the skin for three inches above or over the malleoli, over the anterior border of the tibia, over the tendo Achillis or immediately above the tibial tubercle. A bandage should be evenly and firmly applied over all. To avoid lateral pressure on the malleoli, the distal ends of the strips may be attached to a spreader; the spreader may be conveniently fixed to the stirrup of the splint by means of a webbing strap. A simpler though less easily adjustable method is to carry the traction strips round the side bars of the splint. Pieces of lamp wick ($\frac{1}{2}$ inch wide) are sewn to the two ends of the adhesive strapping strips; these are carried, one under and the other over the side bars of the splint, and then tied in a single knot over the end of the splint. The strapping used must be as far as possible non-irritating. Zinc oxide strapping - will be found suitable.

(ii) Glue. - Glue in place of adhesive strapping became popular as the method of applying traction in the treatment of war fractures. A bad glue is irritating and gives rise to soreness and skin trouble. It requires special preparation. Spirit glue is the most suitable kind to use and has the advantage that it can be applied cold. A useful formula is alcohol 50 c.c., Venice turpentine 5 grams, benzine 25 c.c. The glue is painted with a brush on to the skin or either side of the limb, without previous shaving. After waiting a few moments till the glue has become tacky, two strips of strong and absorbent material, such as gauze, are laid on the sticky surface. No glue should be applied to the outer surface of the gauze strips. A bandage should be evenly and firmly bound over all. No glue should be applied to the skin areas liable to pressure, mentioned in the previous paragraph. The distal ends of the gauze strips should be attached to a spreader or passed round the side bars of a Thomas splint.

(iii) Skeletal Traction. - When, owing to the condition of the skin, it is impossible to use tractions taking purchase from the surface of the limb, some other method must be adopted. The Besley caliper (Pearson's modification) was largely used during the war in

the treatment of fractured femurs, and in the hands of those accustomed to use it was safe and effective. Transfixion pins may be driven into bone, and traction thus taken directly from the bone.

These devices for skeletal traction have certain obvious advantages and are coming more and more into use. Care must, however, be taken as, without precautions, infection along the track of the pin is liable to develop. This will be disastrous if the instrument has transfixed any part of the knee joint, and in any event will cause troublesome sinuses down to the bone should sepsis develop.

We have found that a pin passed just above the os calcis so as to bear on its upper surface, three-quarters of an inch in front of the insertion of the tendo achillis, is a safe and convenient method for exerting traction. A spring horseshoe clip is fitted on to the pin. The method is of greatest value in open fractures of the tibia and fibula or in simple fractures with considerable overlap.

(iv) The anklet. - Great care is required when an anklet is used as the means of getting purchase for the traction straps, on account of its liability to cut the skin or produce pressure sores. It should only be used for the short time necessary in applying forced traction under an anaesthetic on a fracture table. Even for this manoeuvre it is better to use a skein of worsted or a strip of padded webbing.

b. WEIGHT TRACTION. - When a weight is the force employed for continuous traction, the amount should be 6 to 12 pounds in children and 15 to 20 pounds in adults. When employed for "forcible traction" on a mechanical table, the amount may be as much as 100 pounds for a short period. For continuous action the weight should be secured to the spreader of the traction attachment by a cord running over a pulley. It may also be attached direct to the frame of a Thomas knee or Hodgen splint, when the traction strips of strapping or gauze are fixed to the cross-piece of the splint; i.e., the limb fixed to the splint forms one unit, and the weight attached to the splint therefore pulls directly on the limb. It should be noted that the effectiveness of a weight varies considerably, both in relation to the position of the limb and the method of obtaining a hold.

c. FORCIBLE TRACTION. - By this is meant the procedure required to correct the overlap at one operation. The patient must be anaesthetized. The forced employed may either be a weight of from 20 to 100 lbs., or a screw traction, such as can be effected by the use of an orthopedic table, or a pulley and tackle. In this latter method the weight employed can be checked if a Salter's spring balance as used by butchers is inserted between the tackle and its attachment to the limb.

d. COUNTER-TRACTION, or COUNTER-FIXATION. - By this is meant force applied to a limb in a proximal direction, coincident with traction in opposition to it. A plaster of Paris splint effects counter-fixation by the transmission of the upward thrust through the rigid plaster to some bony prominence above the site of fracture.

When an orthopedic table is used for producing traction, counter-traction is obtained by the pressure of the pubic and ischial rami against the fixed perineal mast.

When a Thomas knee splint is employed with a fixed traction (i.e., with the strips of strapping or gauze tied to the cross-piece), counter-traction is automatically obtained by the upward thrust of the force through the side bars and ring against the tuber ischii.

In the case of a caliper splint, counter-traction is effected in exactly the same way.

When, however, a Thomas knee splint is employed with a weight attached either to the traction attachment direct or to the traction attachment via the cross-piece, or when a Hodgen splint is used, or when traction is used apart from any splint, it becomes necessary to employ some means to effect counter-traction. Usually a varying amount of the patient's body weight is used to counterbalance the force of the traction by raising the foot of the bed ten inches. This can be supplemented if necessary by the application of a perineal band or groin-strap. The ends of a looped towel are fixed to the head of the bed, the loop passing over the groin and perineum of the uninjured side.

The methods described above are seldom employed in fractures of the upper extremity; nevertheless, the general principles hold good in the treatment of any broken long bone.

4. PLASTER OF PARIS. - The various forms of plaster of Paris splintage give the most complete and efficient form of external fixation, but the use of plaster is fraught with certain dangers and is only to be recommended for those who have been thoroughly well trained in its application. There is danger that the plaster casing may be covering up a gross deformity, and the hazard of the die is cast on the first application.

In general practice, plaster is not as handy to apply as the standardized ready-made splint. Moreover, its rigidity renders plaster casts dangerous for fractures that are not under close observation, and when applied as complete casings, attention to the nutrition of the muscles is impossible. On the other hand, if the plaster case is bivalved, it is safe and is the most efficient splint.

The most satisfactory mehtod of applying plaster is by means of plaster bandages. The bandage is made from book muslin of a suitable width. The bandages should be freshly prepared, being not so tightly rolled as to prevent the access of moisture to the centre of the bandage and yet not loose enough to make them difficult to handle when wet. Bandages of this kind moistened in a fair bulk of warm water will be found to set with sufficient rapidity for all practical purposes. For padding under plaster, non-absorbent wool applied from a six-inch roll is satisfactory; flannel bandage is not to be recommended. When a close fit of the plaster is required, the padding should be limited to one or more layers of cotton stockinette and the plaster well moulded round the bony points. It is to be remembered that plaster sores arise most often from the friction of a badly fitting

plaster, which rides up and down; careful moulding of the bony points prevents this by affording adequate fixation. Heavy plaster casings are seldom necessary. The splints can be kept light by strengthening the parts exposed to strain by the inclusion of wood laths, or reduplicated strips of plaster bandage.

After the application of a complete plaster casing, it is of the utmost importance that the patient should be examined at intervals during the next twenty-four hours for signs of pressure on the vessels. Interference with the circulation in the distal part of the limb, or severe pain, are always indications for the removal of the splint, or at least cutting it down one side, so as to relieve the pressure.

The safest method to adopt when using plaster for the fixation of a fracture is to cut down the plaster as it is just setting, thus converting the encasing cast into a bivalved plaster. The bi-valve is held in place with a circular bandage, and either half can be easily removed for inspection or for physical treatment without disturbing the fracture.

Chapter XVII

REPAIR AFTER FRACTURES

The process of repair which takes place at the seat of a fracture in a healthy bone is similar to that which is observed after mechanical damage to other tissues of the body. It differs only in that the granulation tissue thrown out in response to the injury possesses the property of being converted into bone.

The histological changes which occur in this process have been carefully observed and interpreted, but as they have little bearing on ordinary practice we shall not describe them here, and will confine ourselves to a general statement of the gross changes which can be observed by the naked eye and with the help of the X-ray.

Following the fracture of a long bone considerable swelling of the whole limb usually occurs within twenty-four hours of the injury. In certain fractures bleb formation and even sloughing of the skin may occur near the seat of fracture. The swelling is, in the first place, due to blood effused from torn vessels, and secondly, to venous obstruction and the effusion of lymph. A certain degree of fever may appear in healthy individuals during the absorption of this swelling, and may persist for a week or more. The superficial swelling gradually diminishes during the process of repair, though oedema may persist both at the seat of fracture and distal to it for some months after the fragments have united. A few weeks after the primary injury a swelling, generally more or less spindle-shaped and of firm consistence, is observed to develop about the seat of fracture; this swelling is in firm continuity with the bone above and below the injury. In many cases this new tissue formation appears to invade and involve the muscles overlying the fracture. A radiogram taken at this period will generally show definite shadows about the fracture, indicating the presence of osteoid tissue between and around the ends of the bone. The tissue laid down in this way is termed callus; when newly produced it has the same histological structure as granulation tissue; in this early period it is vascular and soft and subject to tearing and stretching by slight violence. It gradually assumes firmer consistence as a result of fibrosis and by the deposit of lime salts in its substance. Radiograms show that this deposit of lime first occurs on the callus produced on the deep surface of the periosteum; indeed, in this situation it may be often clearly detected in the first week after the injury in a young bone. The callus between the broken ends is calcified more slowly, but the process is usually well advanced in from four to six weeks after injury. At this time the callus is generally sufficiently strong to prevent displacement in the long axis of the bone unless strong force is applied - angulation of the fragments, on the other hand, may still be easily produced by pressure.

The next stage in the process of consolidation is that in which the calcified callus of osteoid tissue undergoes a gradual process of absorption, while at the same time true bone of normal structure is laid down in its place. This new bone is so deposited that finally, if the apposition and alinement of the fragments be correct, the seat of fracture can scarcely be recognized on clinical examination; a skiagram, however, will usually

show some thickening or irregularity in the bone for many years after. If the bone fragments unite with angular or lateral displacement the new bone remaining after the absorption of the callus, is laid down in such a way as best to meet the strains and stresses to which the bone in its new position will be exposed; and useless prominences are gradually absorbed.

SPEED OF UNION.—The time taken by the callus in becoming solid and finally converted into bone varies within wide limits in different individuals and under different local conditions. Several factors are recognized as being responsible for these variations.

If there is extensive comminution at the seat of fracture, the formation of callus is bulky and rapid; this may be regarded as the result of the free exposure of a large surface of bone and the corresponding release of bone-forming cells. Conversely, when the bone fragments are impacted or broken across transversely and little separated, the callus-formation is small in amount though union takes place in good time. The vascular supply to the fragments is a factor which undoubtedly affects callus-formation. The most outstanding example of this influence, perhaps, is seen in cases where the ends of the bone fragments have become sclerosed and anaemic as the result of inflammation; such a condition is often followed by or associated with non-union. If the surface of a fractured bone is freely exposed to contact with synovial fluid, not only is there little or no callus-formation, but fibrous union or pseud-arthrosis is a common result; the classical examples of injuries of this type are transcervical (intracapsular) fractures of the neck of the femur and fractures of the carpal scaphoid.

Undue movement at the seat of fracture during the process of repair tends to the production of irregular and sometimes excessive callus; this may not be reabsorbed but may remain as a bony formation in the overlying muscle, and the deposit of bone may be sufficient in bulk to obstruct the function of the neighboring joint.

Occasionally, after a fracture there may be little or no callus-formation, and no adequate cause for this sluggishness in the process of repair can be made out. This is most often observed after transverse fractures of the tibia and fibula.

The influence of the patients' age on union is not as striking as might be expected. It is true that in childhood the rate of repair is more rapid than in adult life, but from the time full growth has been reached until extreme old age, the speed and character of bone union show little variation.

Chapter XVIII

COMPLICATIONS OF FRACTURES

A break in a bone necessarily involves some trauma to the neighboring soft parts; in some instances this damage may outweigh in importance that of the fracture itself. The local injury may also lead to disturbances of the vascular and nervous system as exemplified by embolism and delirium tremens.

In this chapter the subject will be introduced by a consideration of the abnormalities which may be met with during the process of repair in simple fractures. This will be followed by an account of the damage which may be incurred by the soft structures in the neighborhood of the injured bone. Notes on the commoner constitutional complications associated with fracture conclude the section. Infection of fractures is dealt with in a separate chapter following this.

DELAYED UNION

The rate of repair after fractures varies widely in different bones, at different levels of the same bone, at different periods of life, and in different individuals. It is thus clear that the distinction between delayed union and non-union is not a well-defined one. In general it may be laid down that a diagnosis of "non-union" should not be made till a year or more has elapsed from the time of injury.

The term delayed union may be applied to any fracture in which consolidation has not occurred within the average period for the bone involved in an individual of the type concerned.

TREATMENT - Before initiating any special treatment investigations should be made to exclude the presence of syphilis or any local disease which might account for the condition. If a positive Wassermann reaction is obtained, a course of anti-syphilitic treatment will probably lead to the establishment of the normal process of bone-repair. Similarly, sound bony union is delayed during the active stage of rickets, but proceeds normally in patients with healed rickets.

In cases in which the delayed union cannot be traced to any general or local disease, local treatment should be instituted with a view to stimulating callus-formation. Vigorous massage of the limb, or the firm rubbing together of the broken ends of the bone, while the patient is under an anesthetic, may be the first procedure undertaken. Passive congestion of the limb involved is sometimes successful in expediting consolidation. The congestion is induced by the application of an india-rubber bandage, proximal to the injury; it is applied firmly enough to render the distal part of the limb purplish-blue from venous congestion, but not so tight as to interfere with the arterial circulation. The bandage so applied should be left in place for a period of an hour or two once in the day; elevation of the limb and massage should follow the application in order to disperse the general edema which will have resulted. The application of the bandage should not give rise to pain; if it does so it indicates that the pressure is too great.

This procedure was originally described by H. O. Thomas under the term of "Hamming and Damming," but Thomas applied the rubber tubing both above and below the fracture. The method of passive congestion here advocated differs slightly in detail from that introduced by him, and approxmiates to that subsequently adopted and popularized by Bier.

In the lower extremity the application of an ambulatory plaster casing or caliper splint, which allows the patient to walk and bear some weight on the limb while alinement is controlled, is a procedure which in some measures reproduces the conditions of the two above methods of treatment and is to be recommended.

The injection of a small quantity of the freshly extracted blood of the patient into the tissues about the fracture has been advocated as a stimulus to callus formation. We have seen no striking results from the use of this method.

The general health of the patient should receive attention, good food and open air being perhaps the most important factors.

NON-UNION

This term may be applied to a fracture in which bony union sufficient to re-establish the full function of the bone involved has not occurred within a period much longer than would normally be necessary for sound union to occur. From what has been stated above it will be seen that no exact time limit can be laid down whereby a case regarded as delayed union is to be definitely classified as one of non-union.

Non-union is rare, except in a few situations in which its occurrance is determined by a recognizable local factor. In most other instances some definite local or general disease is the cause.

The local factor which most commonly tends to prevent bony union is the free access of synovial fluid to the fractured surfaces: the classical examples of this kind are unimpacted fractures of the neck of the femur and fractures of the body of the carpal scaphoid. The interposition of soft tissues between the broken ends of the bone is another cause, and excessive loss of bone tissue at the seat of fracture, most often seen as a result of certain gun-shot injuries, is a third.

Deficient blood supply may be responsible for slow union or lead to non-union. This is most commonly seen where an osteomyelitis at the seat of fracture has produced a sclerosis of the bone ends and the consequent shutting down of normal blood channels.

Anatomically, the non-union of fractures may be associated with two different conditions, namely, (1) pseudarthrosis and (2) bone deficiency. Fibrous union is sometimes classified as a form of non-union, but may be more properly dealt with under a separate heading.

PSEUDARTHROSIS-When there is free movement between two fragments which fail to unite, the fractured surfaces of the bone become smoothed off and

eburnated, and a fibrous capsule forms around the ends within which a fluid resembling synovia is secreted. This false joint is most commonly seen in the neck of the femur, and occasionally in the shaft of the humerus.

BONY DEFICIENCY OR SEPARATION - The broken surfaces of the fragments are widely separated as the result of displacement or loss of substance, the soft parts intervene, and prevent bony union or even firm fibrous union. The condition is commonly seen as the result of gunshot injuries; in civil practice a considerable length of the shaft of a bone may be destroyed as a result of osteomyelitis and lead to a similar result.

FIBROUS UNION

The fractured ends are firmly united by fibrous tissue and not by bone. This is commonly seen in fractures of the patella and olecrannon which have not been treated operatively. In many instances fibrous union may be associated with fair function. It must be recognized that in most fractures classified as ununited the bone ends are joined together by fibrous tissue, but this is not strong enough to allow of normal function.

INFLUENCE OF DISEASE ON UNION

Local disease of bone may delay or cause complete failure in union.

An osteomyelitis which follows the infection of an open fracture is perhaps the commonest example of such an influence. A pyogenic infection invariably hinders callus-formation and delays consolidation, and when it is prolonged may produce such sclerosis in the ends of the bone and fibrous tissue-formation in the surrounding soft structures that all power of bone regeneration at the seat of fracture is lost and a pseudarthrosis is formed. The loss of osteogenetic function may be attributed to two causes, viz. (1) destruction of osteoblasts, and (2) reduction in the vascularity of the bone ends.

Conditions such as malignant growths of the bone or tuberculous caries, which may have been responsible for a spontaneous fracture, also interfere in varying degrees with normal repair.

Certain constitutional diseases have the effect of delaying bone union after fracture. Of these, syphilis is the most important. Quite apart from obvious local disease of the bone due to syphilis, its presence in the system has an inhibiting effect on osteogenesis. In the late syphilitic manifestations of general paralysis and tabes dorsalis the same effect is observed.

In the active stage of rickets union after a fracture takes place rapidly by means of a soft osteoid tissue, but the process of consolidation is slow, and a tendency for the production of deformity under normal strain at the seat of injury may persist for some months.

Severe anemias and wasting diseases are credited with the effect of delaying the process of bone repair, though it must be said that the evidence on the subject is not very full. Scurvy and other rare conditions affecting the bones also have the effect of inhibiting union. In osteitis deformans

and in fibrocystic disease repair takes place after fracture, usually within the normal time.

INJURIES TO BLOOD VESSELS

ARTERIAL DAMAGE - Small blood-vessels in the bone substance as well as in the surrounding soft parts are inevitably torn across at the time a fracture occurs. The size of the vessels so damaged, and the degree to which arterial hemorrhage from them is controlled by apposition of the bone surfaces and firm fixation, will determine the extent of the subsequent hematoma. Occasionally, a large artery near the seat of fracture may be occluded by pressure, torn by the fragments, or damaged by the force producing the injury.

After occlusion of a large vessel, the pulse distal to the injury is abolished or weakened, and the extremity will become relatively blanched. Later, some degree of gangrene in the distal part of the limb may occur, or, if the collateral circulation is sufficient to maintain nutrition, the appearances of normal circulation soon return. A traumatic aneurysm or aneurysmal hematoma may develop at the seat of the injury; it will form a palpable pulsating swelling and will probably produce severe venous obstruction from pressure. In infected open fractures, and especially in missile wounds, secondary hemorrhage is liable to occur should a large vessel have been damaged.

TREATMENT - Sometimes the main vessel of a limb is torn in association with a fracture and an arterial hematoma develops rapidly. This will lead first to venous congestion and finally to complete stasis of blood flow, both arterial and venous. If such a condition is recognized promptly, open operation should be carried out; the injured vessel should be cut down on, the effused blood cleared out and the damaged vessel repaired or ligatured. This operation is the only method of preventing gangrene if a main vessel such as the axillary or popliteal has been torn.

When a diagnosis is made of complete occlusion of the main vessel of the extremity the whole skin of the limb should be carefully cleaned with methylated spirit, dried and powdered. A voluminous protective dressing is applied and the limb elevated. The general circulation is maintained in as active a state as possible by the administration of stimulants in order to assist the development of the collateral circulation. If gangrene occurs, unless serious infection of the dead tissue is present, no operative procedure should be undertaken until a line of demarcation is established. If, despite precautions, the gangrenous area should become infected, amputation at a distance will be imperative.

THE THROMBOSIS OF VEINS in the neighborhood of a fracture is probably not uncommon. Its establishment in a main vein will produce severe general edema of the affected extremity, but it does not lead either to urgent symptoms or to serious complications later. The swelling, which occurs commonly in the lower extremity after fractures when the patient first commences to walk again, is best treated by firm bandage support extending from the toes to the level of the knee.

PULMONARY EMBOLISM

This is a rare complication of fractures, only a few cases having been recorded. It would appear to be commoner after open operations on bones than after simple fractures due to accidents. No effective mehtods of treatment are known despite the manifold suggestions which have been made.

ISCHEMIC PARALYSIS (Volkmann's Contracture)

Ischemic paralysis is a condition of the muscles which results from an obstruction of the circulation of an extremity. Such obstruction need not be complete in order to produce the symptoms, and need not exist for more than a few hours.

In civil practice the condition is most commonly seen in the forearms of children as a complication of fractures or dislocations about the elbow. The pathological change is in the muscles; the muscle substance partially necroses, is absorbed and is then slowly replaced by fibrous tissue. In the forearm the condition affects chiefly the flexor muscles and leads to a claw-like deformity of the hand, associated with inability to extend the fingers fully unless the wrist be in the position of extreme flexion.

The essential cause of ischemia, namely, obstruction to the circulation in an extremity, is generally produced by splints or tight bandaging. Occasionally, it would appear that it may be brought about by the primary damage to the vessels and the formation of a hematoma in the anticubital fossa apart from the pressure of any splint or apparatus.

The treatment is essentially prophylactic. After the application of any splintage, whether by bandage, strapping or plaster of Paris, the thumb and fingers of the affected extremity should be left partly exposed in order that they may furnish a gauge of the condition of the circulation of the limb. In the event of the exposed part becoming cyanotic, or failing to give a brisk capillary response to pressure, there should be no hesitation in at once cutting down the splint and re-applying it with less tension or even in lessening the angle of flexion in which the elbow joint is held. When once the deformity is established, the correct treatment consists in a gradual stretching of the damaged muscles, a procedure which requires care and patience.

FRACTURES INVOLVING INJURIES TO JOINTS

When a fracture extends into a joint the injury produces a hemarthrosis as an immediate result of the accident. Later the function of the joint may be seriously interfered with on account of the irregularities of the joint surface produced by the union of the displaced fragments. Moreover, joints so damaged are particularly liable to become the seat of osteo-arthritic changes. In the case of open fractures there is the additional possiblity of the development of septic arthritis. The treatment of this condition is considered in the chapter on open fractures.

In simple fractures involving joints it is of the greatest importance to replace the fragments so that the normal contour of the articular surfaces is restored; after this has been effected it is best to immobilize the joint

for a period of three weeks. At the end of this time sufficient consolidation of the fragments will have taken place to allow of gentle movement of the joint without risk of displacement; the full action of the joint and active movements should be gradually worked up to, without the use of force sufficient to cause pain.

The alternative method, which is sometimes recommended, is to treat the joint by massage and movements from the onset.

FAT EMBOLISM

As the result of a fracture fat globules may find their way into the general circulation by way of the capillary veins and pass thence to the lungs, where they may form small emboli; they may be carried further into the systemic circulation and obstruct the capillaries in the brain or kidneys. Fat embolism, sufficiently severe to cause serious symptoms, is rare. The commonest type, as might be expected, is the pulmonary form; this is associated with dyspnea, cyanosis and irregular action of the heart. If the embolism involves the brain it may produce indefinitely localized irritative lesions of the cortex which may progress to coma.

The prophylactic treatment is the immobilization of the fracture. Once the symptoms have developed no active treatment has much influence. Some authors recommend the intravenous infusion of large quantities of saline solution with a view to washing the emboli through the capillaries.

CRUTCH PALSY

The paralysis of the arm which may follow the continued use of crutches, though not properly a complication of fractures, is of sufficient practical importance to justify its inclusion here. The palsy results from the direct pressure of the crutch on the musculo-spiral nerve where it lies in relation to the postero-internal aspect of the humerus. The first clinical sign noticed is weakness in the action of extending the wrist, and if the use of crutches is not at once discontinued complete paralysis of the muscles supplied by the musculo-spiral nerve will develop in a day or two.

Treatment should primarily be prophylactic. If axillary crutches are used, a well-placed hand rest should be provided. The crutch should press laterally against the side wall of the chest, not directly upwards into the axilla. The elbow crutch which was popularized during the War is well suited to able-bodied men and avoids all risk of injurious pressure on the nerves. Once the palsy has developed the use of axillary crutches must be discontinued, and the affected muscles held in a relaxed position on a "cock-up" splint and kept in good condition by massage and faradism until conduction in the nerve trunks is restored. Recovery is the rule and usually takes from three weeks to three months; in slight cases which are noticed early and in which the faradic response is not lost, three weeks will usually suffice for the restoration of full and controlled power.

Chapter XX

PLASTER OF PARIS

Plaster of Paris is a native sulphate of lime, and is really crushed gypsum which is ground and calcined in ovens at a temperature between three and four hundred degrees Fahrenheit, at which temperature gypsum parts about 93 per cent of the original water of crystallization and is converted into an amorphous anhydride, which possesses the power of recombining with water to form crystals. When mixed with water a chemical union takes place which is called recrystallizing or "setting." In "setting" it expands a very slight amount, calculated at one-five-hundredths of its volume. This is most important as it demonstrates that plaster bandages cannot shrink about the leg in drying. Sores under the plaster bandages are almost invariably due to improper application, to the lack of cleanliness on the part of the patient, to foreign bodies getting under the plaster or to obstruction of circulation under the plaster.

The change in "setting" is accelerated by the addition of salt, which cuts the time nearly in half if added to an amount not exceeding 3 per cent. Other less common chemicals like sulphate of potash, borax, and sulphate of zinc all hasten "setting." Common alum hastens the "setting," but is objectionable because the common plaster fills with bubbles. Glycerin, molasses, and certain other substances retard "setting," and glue, which enters into sizing the ordinary crinolin, is another of the substances which delays it, and this is of much practical importance. Dental plaster is a finer, quicker setting grade than ordinary plaster. It is much used by dentists, and is of two kinds, either a plaster mixed with potassium sulphate as an accelerator, or pure finely ground plaster of high grade.

It may be formulated in the use of plaster that anything which accelerates "setting" tends to diminish the durability of plaster bandages. Pure plaster should set in seven minutes and possesses a tensile strength of about 400 pounds to the square inch.

Portland cement when mixed with plaster of Paris in amounts varying from 10 to 20 per cent increases the durability of the case but delays its "setting" somewhat and adds to its weight.

The bandage material to be impregnated with plaster is a book-muslin sized with starch and not with glue. The meshes should not be finer than twenty to twenty-five threads to the inch.

Preparation of Plaster Bandages. The gauze should be torn into lengths of about 4 yards for the ordinary bandage, and 3 yards for bandages for small children, in widths of 3, 4 or 6 inches according to the use. For clubfoot in young children a 2-inch bandage is sufficiently wide. When the muslin has been torn into bandages, these should be folded on each other and the loose threads removed from the edges by a pin. Many forms of machines for rolling bandages have been described, but on the whole the general practice is to have them rolled by hand.

The muslin bandage is laid flat on the table with a heap of plaster near it. A handful of the plaster is then laid on the bandage and with a flat piece of splint wood or with the hand this plaster is pushed along over the bandage and any excess of plaster thus removed. The bandage is then pulled, filled with plaster and rolled. Bandages should be rolled loosely, for if they are rolled tightly, the center of the bandage will not become saturated. They should be kept in a tin box and in a dry place, for if exposed to moisture they will deteriorate and if kept for a very long time under any circumstances, they will prove unsatisfactory.

For use a pail is filled about 6 inches deep with warm water, and if quick "setting" is desired a teaspoonful of salt is added. The bandages are then set on end in the water and let alone until the bubbles cease to rise. They are then squeezed dry by holding them with one hand over each end of the bandage to prevent the escape of plaster. If they are left in the water too long before use, they will "set" in the water and be of no value. For this reason it is wise to keep only one or two bandages in the water ahead of the surgeon.

Plaster bandages when applied contain a large amount of water and should be left uncovered. If they are covered by bed clothes or clothing the water will not evaporate, proper chemical change will not take place, and the bandage may be ruined. If X-rays are to be taken through plaster no attempt should be made for forty-eight hours after application, as apparently up to this time the bandages contain too much water. A bandage 4 or 5 inches wide and 4 yards long into which the plaster has been rubbed should weigh about 6 or 8 ounces.

Application of Bandages.

Protection of the Skin. The protection of the patient's skin is of the utmost importance. It is not desirable to put a plaster on skin with an eruption, especially scabies, and in this connection it should be mentioned that the occurrence of one of the eruptive skin diseases, even chicken-pox, may cause serious ulcerations under the plaster. Plaster should not be applied directly to the skin. In the application of plaster jackets a layer of stockinette should be put on, and the bony prominences padded with felt. In the extremities, however, it is generally better to use sheet wadding, torn into bandages 4 inches wide, and of this at least two or three layers should be applied. It is particularly important to provide for thick padding over bony prominences, such as the hip, the malleoli, and the knee. Cases of foot drop occasionally originate from pressure on the external nerve outside the fibula.

The bandage should be applied by straight circular turns, or by a figure of eight. In applying such turns, in the leg, for instance, the lower edge of the bandage will hang loose while the upper edge is tight. This should be remedied by taking a pleat in the lower edge which will make it lie smoothly. Plaster bandages should never be "reversed," and only be put on with enough tension to keep them from sagging, and should never be pulled tightly at any part of the application. They will "set" better if smoothed by the hand with each application, the smoothing following the line of the bandage.

"Reversed" turns, or tension, or correction of the position of the limb after the plaster has begun to set, will result in folds in the deeper aspect of the bandage, which become sharp ridges, which may cause sloughs and irritation. From six to ten layers of a properly applied bandage are enough to give proper strength.

For a workman-like finish the sheet wadding should project somewhat above the top and bottom of the plaster, and just before the bandage is finished, it should be turned down and one or two turns of the bandage made to hold it, leaving the sheet wadding exposed for about half an inch at the top and bottom of the bandage. Care should be taken in application that the assistants do not make finger marks on the bandage in holding the limb, because if they do, these will result in prominences on the inside; and while the plaster is drying care must be taken to see that the heel does not rest upon a flat surface, which would press in the plaster, and that indentations are not made by any other means.

After the application of a plaster bandage, the circulation should be tested by seeing if the return of blood in the ends of the toes and fingers is of normal rate, and the parents or patients, especially in hospital outpatient practice, should be cautioned about watching for any disturbance of circulation in the toes and fingers, and instructed in splitting the plaster if anything of the sort occurs.

Plaster bandages may be strengthened if desired by the use of plaster "ropes" or ribs of plaster, which are made by twisting and folding the bandage until they form a rope of the desired length of about one inch in diameter. This is then laid on where extra strength is desired and incorporated in place by the subsequent bandages. In doing this it is particularly desirable not to pull these bandages tight as otherwise a dead space will be created at the sides of the "rope." Plaster "ropes" are particularly useful in the application of a plaster spica at the hip, and in plaster jackets. They are occasionally very useful in the ordinary circular leg plaster where one or two ropes at the back enable one to put on a much lighter plaster than would otherwise be possible. The use of wire gauze, pieces of metal, thin strips of wood, etc., has not in the experience of the writers proved necessary or desirable.

Splitting the Bandage. When plaster of Paris bandages have been used in fractures, or after operations on the limbs, it is desirable in most cases to split them as soon as they are dry as it adds very much to the comfort of the patient without diminishing the efficiency of the bandage. A plaster bandage forms a very rigid encircling ring, and in the presence of even slight swelling it may become painful or dangerous.

Bivalving may be performed when the plaster is dry by the use of one of the regular plaster cutters. These are of various patterns. The line in which the plaster is cut should be about the middle on both sides so that re-entrant angles are not formed. If the anterior part embraces one-third of the circumference, it will be difficult to get the arm or leg out of the posterior shell. The two halves of the plaster should then be fastened in place by webbing straps and buckles, or in case

these are not available, by adhesive plaster. The plaster cutters do not work satisfactorily on wet plaster and if it is desired to bivalve the plaster immediately it may be done by using a knife, known as a shoe knife, which has a sharp concave point. If the strokes are made parallel to the surface of the plaster, there is little or no danger of cutting the patient as he is protected by a layer of sheet wadding and stockinette underneath. The use of metal strips pushed under the plaster to guard against the use of the knife is unnecessary and the use of saws in general is much less satisfactory than that of the cutters or knife.

Dangers of Plaster Bandages. Plaster bandages should not be uncomfortable, and continued local pain, especially in a child, is an indication for a removal and investigation. A foul smell coming from the plaster is generally an indication of a slough underneath, and such sloughs are generally produced by some foreign body dropped inside the bandage by the child, by an improperly applied bandage with pressure over the bony landmarks, by pressure, ridges or marks left on the inside from careless application, by vermin, by uncleanly habits on the part of the child, which result in the plaster becoming urine soaked, by the occurrence of the eruptive diseases, or by increasing deformity, as in the knee joint for example, or in the spine, where in an increasing deformity the skin may be pressed so hard against the unyielding plaster that a slough results. Sloughs may occur, however, without any painful symptoms.

Disturbances of the circulation are of the highest importance, and every plaster, where there is any definite slowing of the return of blood in the fingers or toes, or any considerable swelling of the fingers or toes, should be immediately bivalved, the lid removed, and all constricting soft bandages cut through. The latter point is most important.

Changing Plaster Bandages. Plaster bandages may be kept on as long as may be desirable and six months is not an excessive time. If the bandage is kept on for this length of time the skin will be found dry and in brown horny flakes, but this is not objectionable and far preferable to the traumatism of reapplication, which is so often detrimental. It must be remembered, however, that atrophy of muscle and bone occurs in plaster of Paris bandages and therefore that on general principles they should be kept on as short a time as possible.

Chapter XIX

ORTHOPEDICS

Operations on Bones and Joints

Because of the susceptibility of joints to infection, and the fact that a foreign body is often allowed to remain in the wound in open operations for fracture, even more careful and painstaking attention is paid to asepsis than in other operations.

Therefore a special technic is employed:--We shall call this "Super Technic." It consists in the careful observance of a large number of details.

1. All materials used in the operation--gloves, instruments, sponges, suture materials--are sterilized for double the usual time.

2. Nothing that has not been boiled must touch the interior of the wound.

3. The gloved hand must never be introduced into the wound nor touch anything going into the wound. To make doubly sure of this, white cotton gloves are worn over the rubber gloves by the nurse, the operator and his assistants. In this way, when the gloved hand touches the wound or the end of the instrument that has been in the wound, it stains the glove with blood. The cotton glove is then immediately changed. At first, this entails considerable hardship upon the operator and his assistants, requiring them to change their cotton gloves frequently during the operation. However, as they become accustomed to the technic, this necessity becomes less frequent.

4. All sponges introduced into the wound must be held by forceps.

5. All skin must be well covered with towels up to the edge of the incision, and held there with towel clips. To do this the usual method of applying the towels must be modified. Two towels are taken, folded in half and placed one over the other with their folded edges superimposed. The folded sides of the towels are placed so as to follow the line of the incision. A towel clip is adjusted at each angle of the wound so as to catch both towels and the ends of the incision. The folded side of the upper towel is attached to the exposed edge of the wound with two towel clips. The towels are turned to the opposite side and the folded edge of the towel that is now uppermost is attached to the other wound edge with two towel clips. On folding back the uppermost towel the wound is exposed with all skin surfaces covered.

6. Nothing that has touched the skin is allowed to enter the wound.

7. No fluids of any kind are introduced into the wound.

8. If possible, no instrument should be used more than once or twice in the wound, without being resterilized.

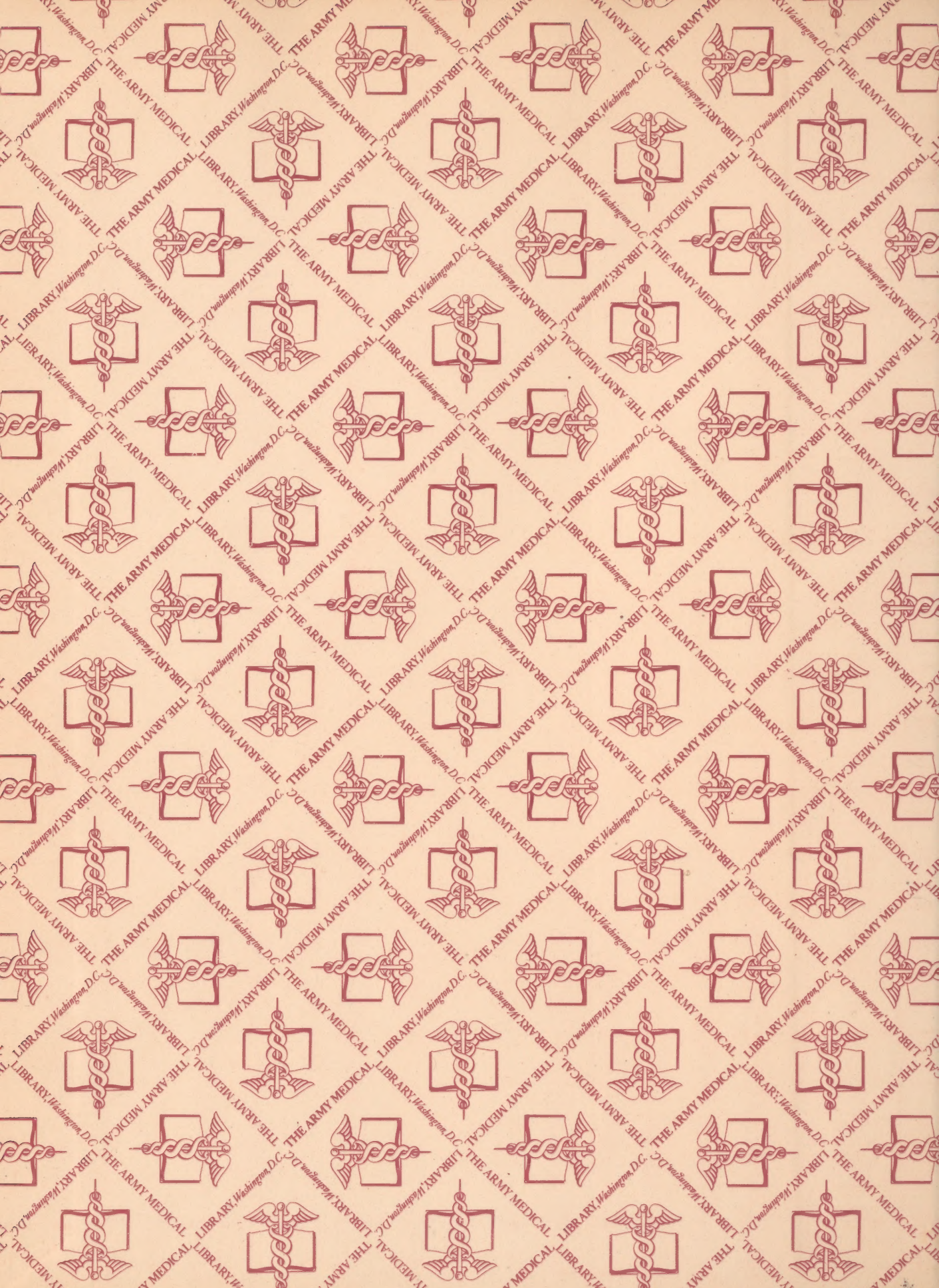
9. All ligatures are tied with forceps. This technic is readily acquired with a little practice. The nurse passes the ligature with an artery clamp on each end.

10. All sutures are threaded on the needles with clamps. The nurse must hold the needle in one clamp and the catgut with the other. A convenient way is to use a self-threading, split-eye needle. Grasp the catgut with a smooth anatomic forceps close to the point where it is to be threaded and push it down on the split-eye of the needle.

Considerable difficulty is encountered in cutting and threading catgut from the ordinary tube, without touching it with the gloved hand. This can be readily overcome, if the catgut is taken from reels instead of from the regular tube. The outer glass casing is broken and the inner tubular reel is dropped into a basin of alcohol. When the catgut is desired, the nurse grasps the end of the catgut protruding through the perforation with a clamp, uncoils the amount required and cuts it. The reel drops back into the alcohol with the end of the catgut still accessible and the catgut which is to be used has not been touched except by an instrument.

11. Needles should not be used more than twice without resterilization.

12. All skin sutures are introduced from within the wound outward. A skin needle is used only once.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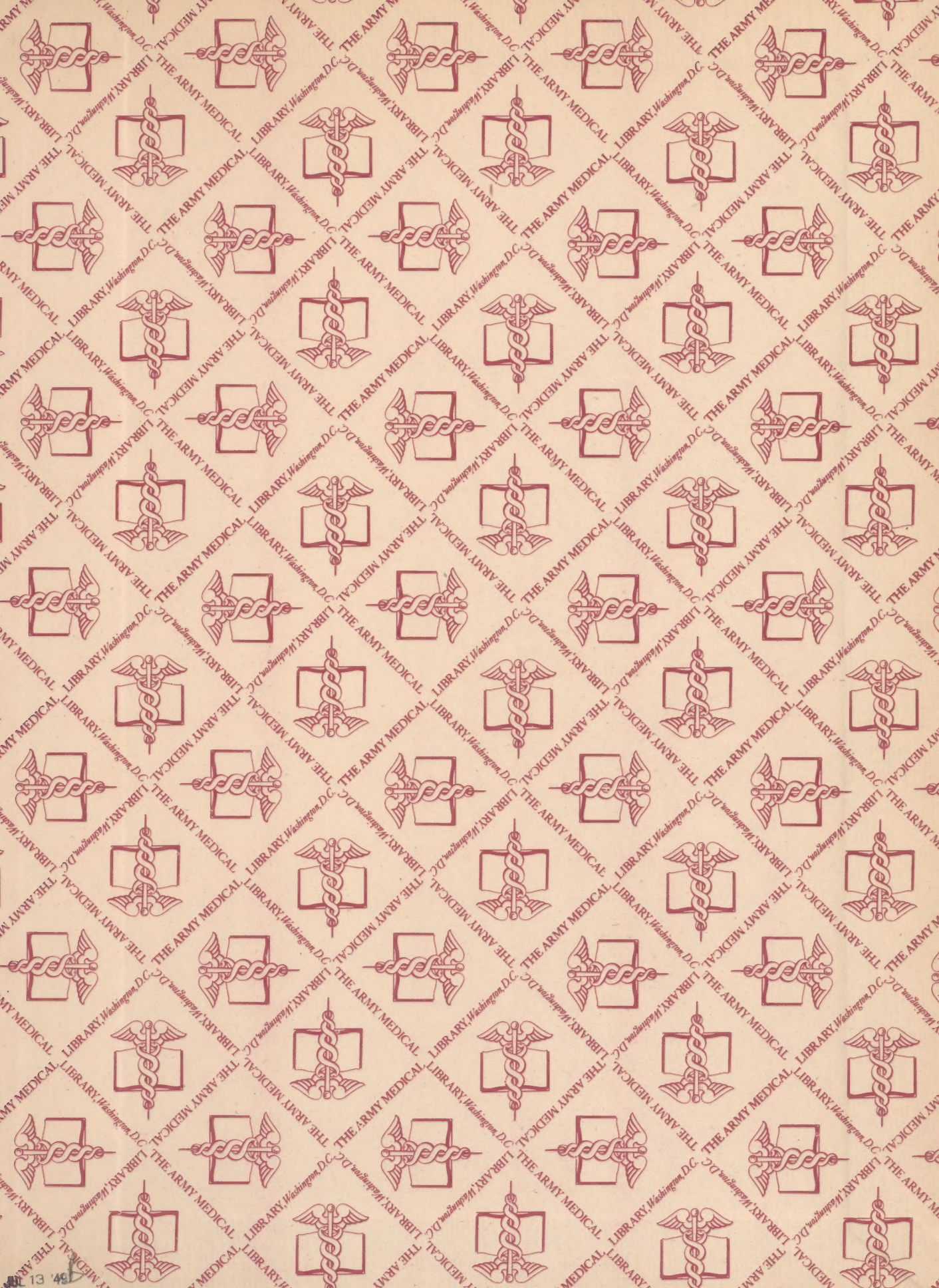
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